FIG. 1

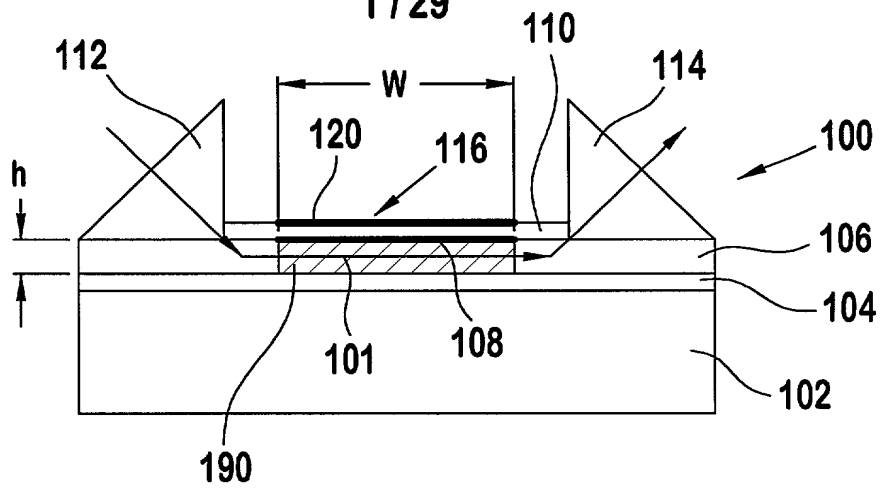



FIG. 2

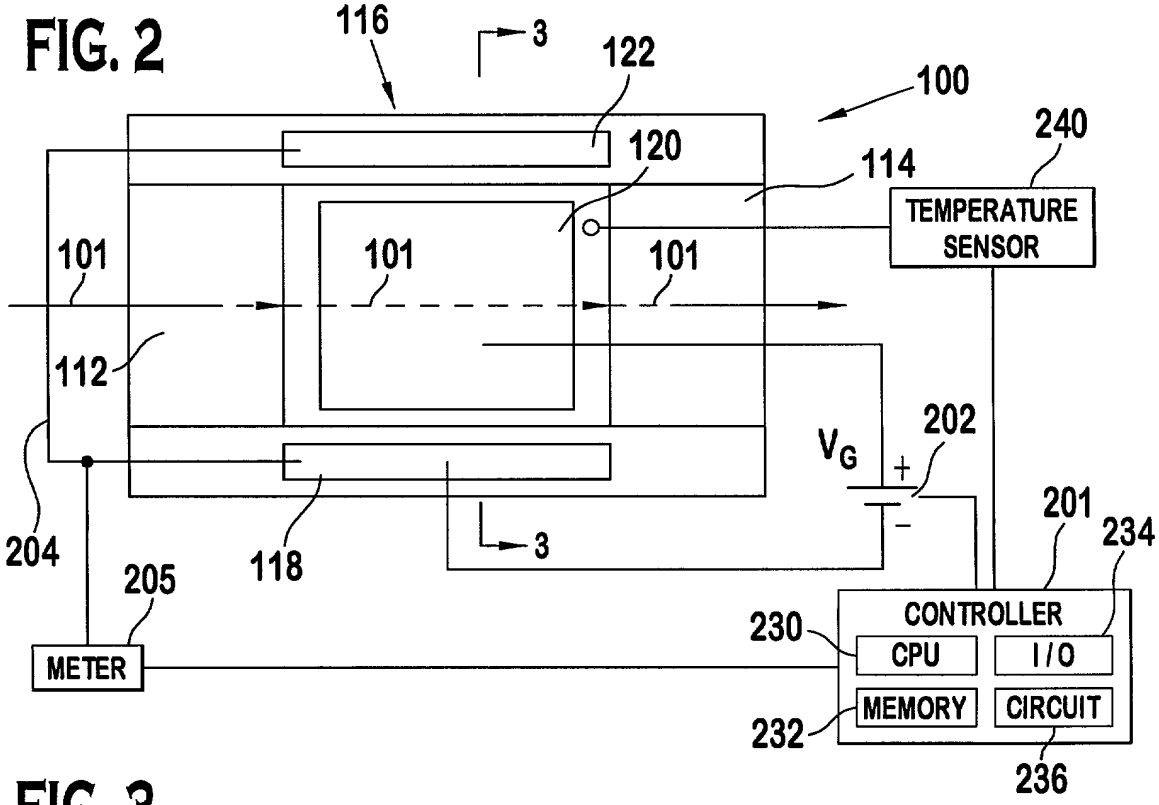



FIG. 3

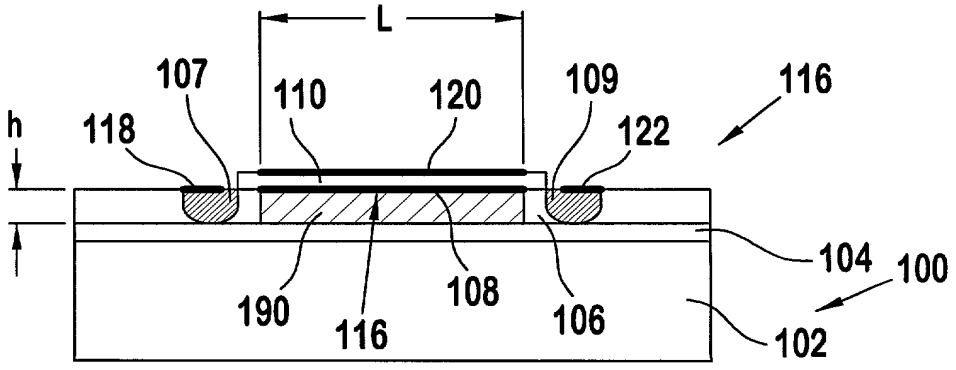


FIG. 4

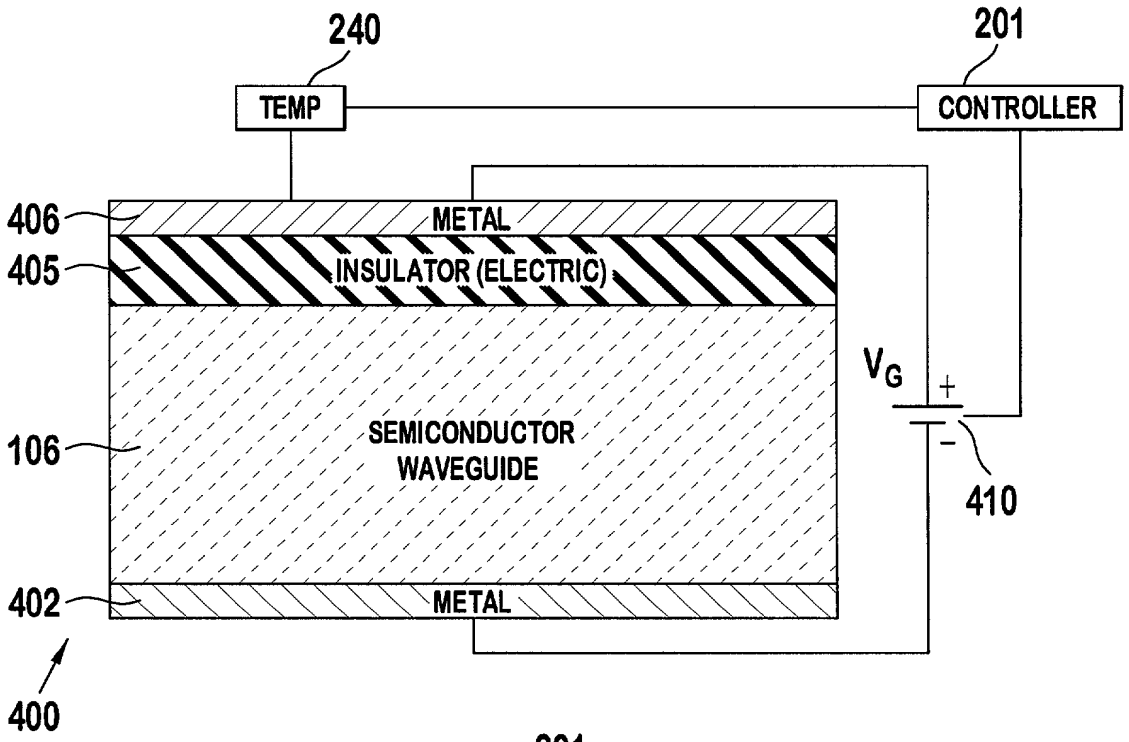

240
201
TEMP
CONTROLLER
406
METAL
405
INSULATOR (ELECTRIC)
$V_G$
+
106
SEMICONDUCTOR
WAVEGUIDE
−
410
402
METAL
400

FIG. 5

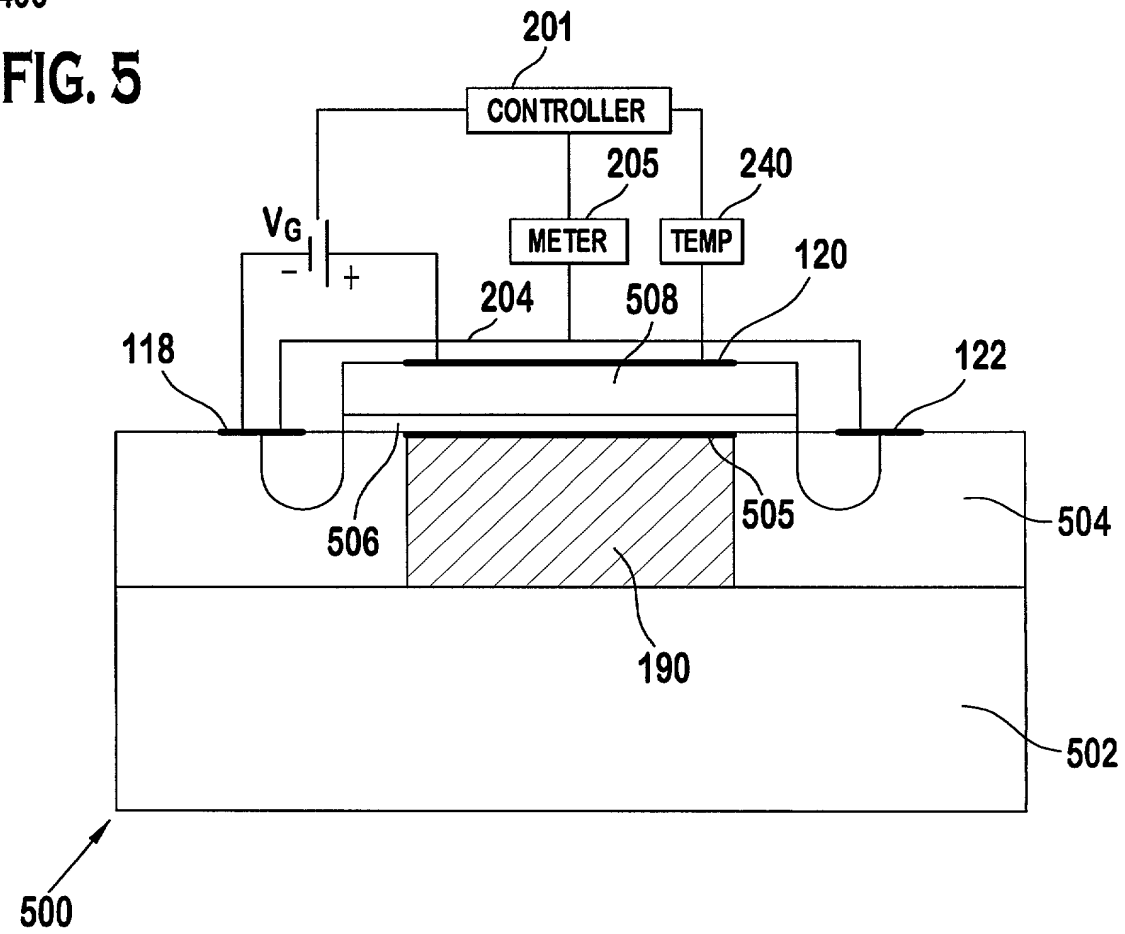

201
CONTROLLER
205
240
$V_G$
METER
TEMP
120
204
508
118
122
506
505
504
190
502
500

FIG. 6

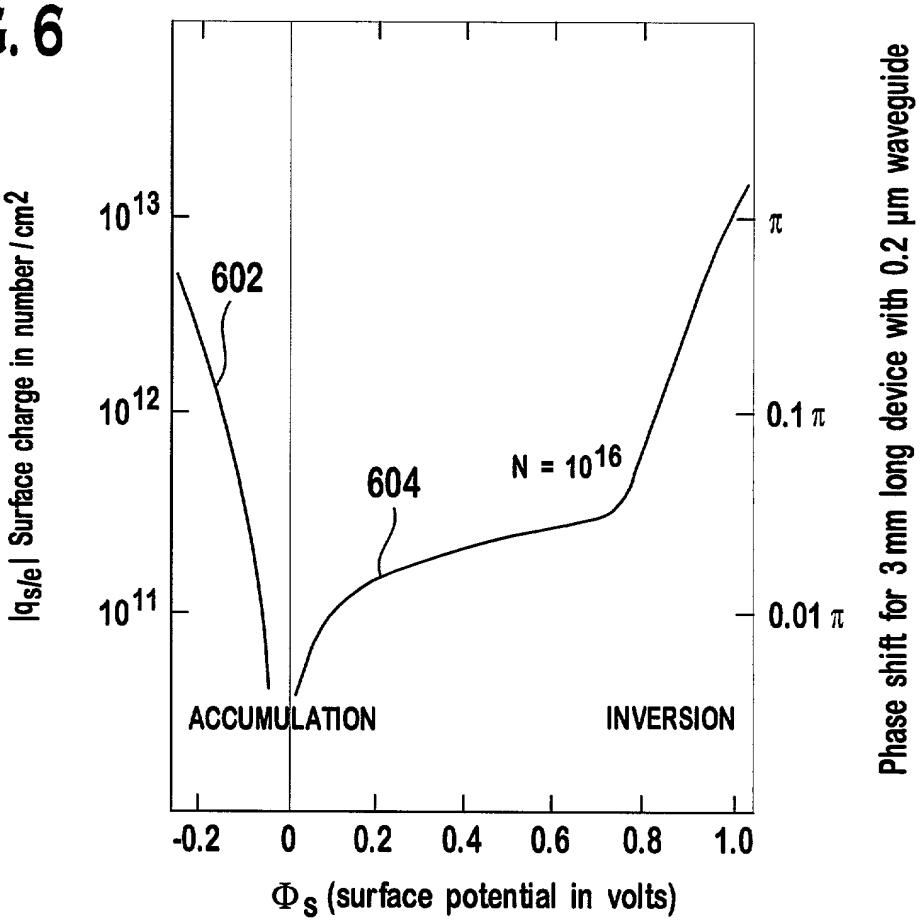

$|q_{s/e}|$ Surface charge in number / cm$^2$
$10^{13}$
$10^{12}$
$10^{11}$
602
604
N = $10^{16}$
ACCUMULATION
INVERSION
-0.2
0
0.2
0.4
0.6
0.8
1.0
$\Phi_s$ (surface potential in volts)
$\pi$
0.1 $\pi$
0.01 $\pi$
Phase shift for 3 mm long device with 0.2 µm waveguide

FIG. 7

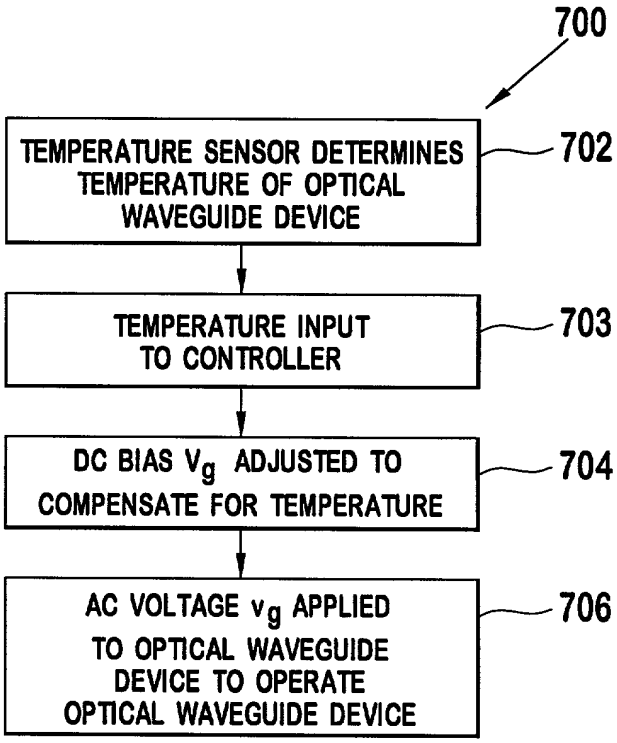

700
TEMPERATURE SENSOR DETERMINES TEMPERATURE OF OPTICAL WAVEGUIDE DEVICE
702
TEMPERATURE INPUT TO CONTROLLER
703
DC BIAS $V_g$ ADJUSTED TO COMPENSATE FOR TEMPERATURE
704
AC VOLTAGE $v_g$ APPLIED TO OPTICAL WAVEGUIDE DEVICE TO OPERATE OPTICAL WAVEGUIDE DEVICE
706

FIG. 8

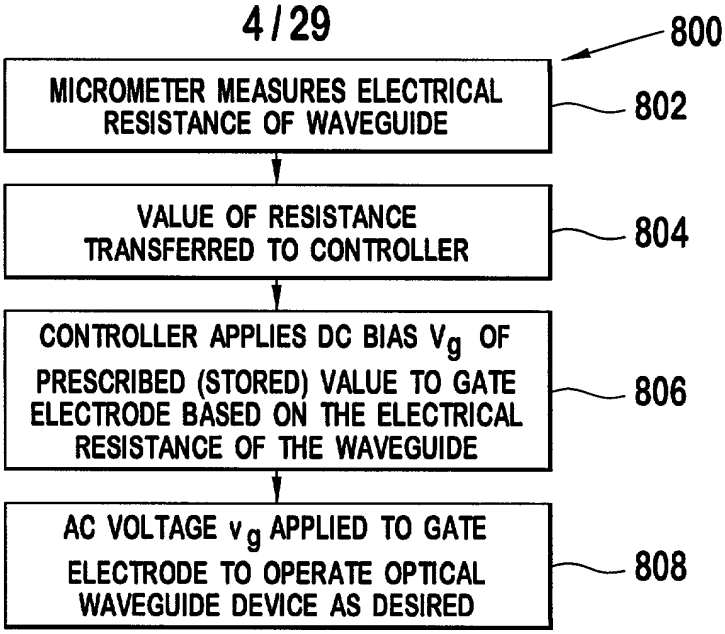



FIG. 9

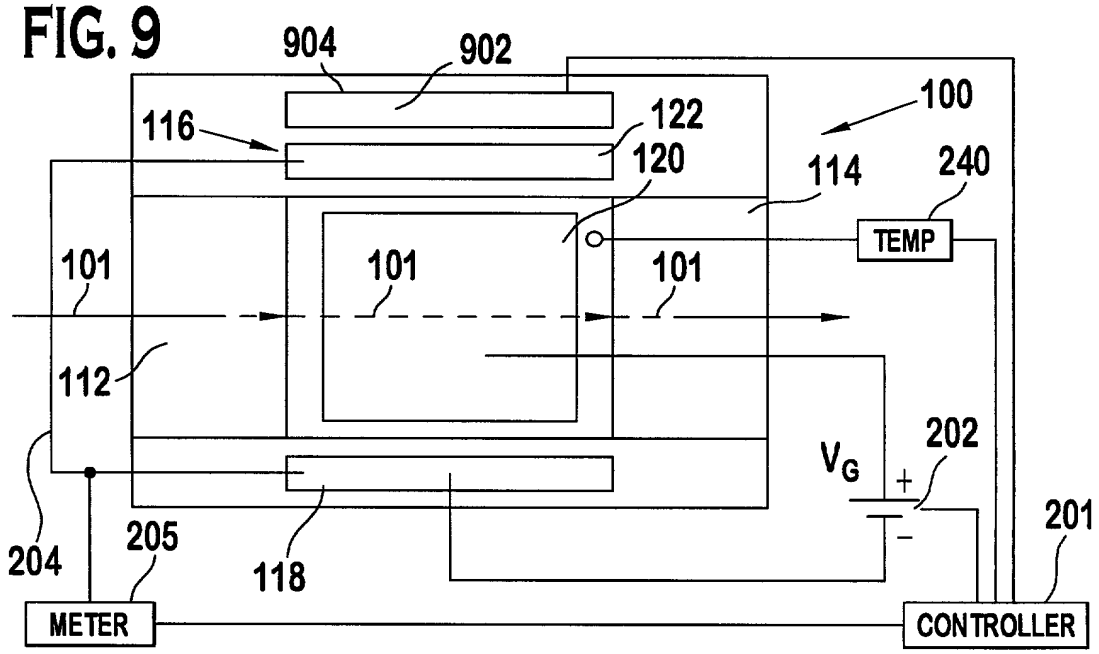



FIG. 10

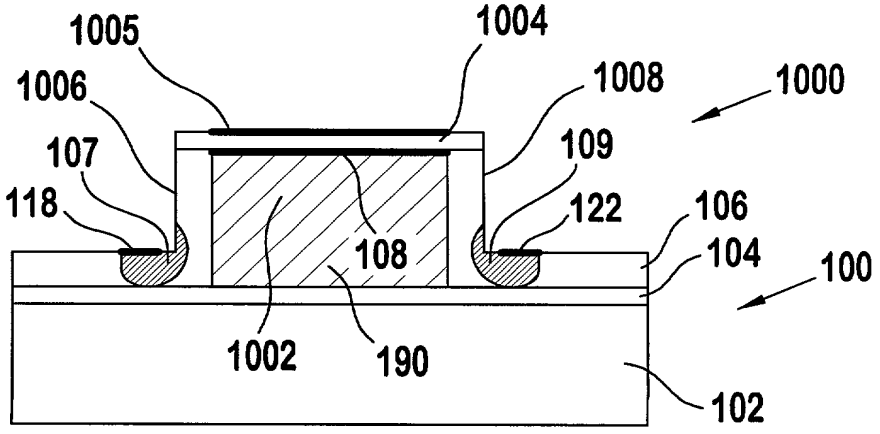


FIG. 11

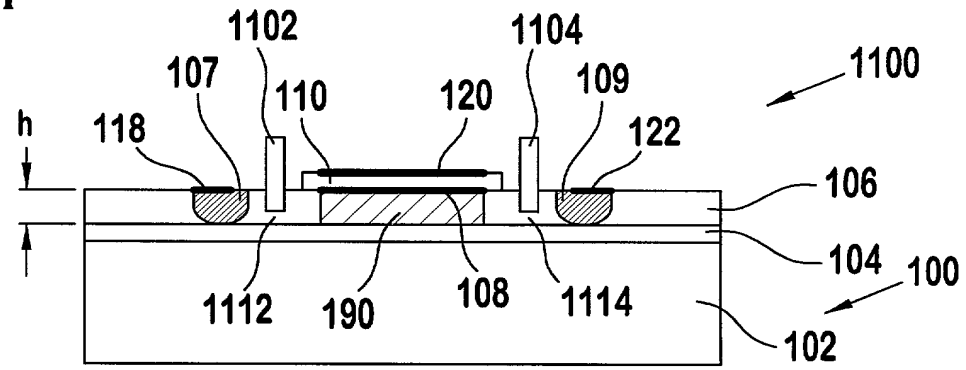



FIG. 12

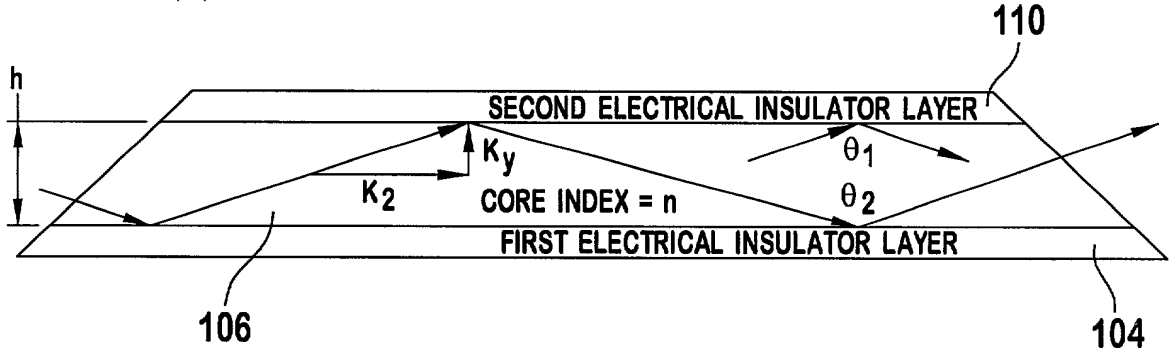
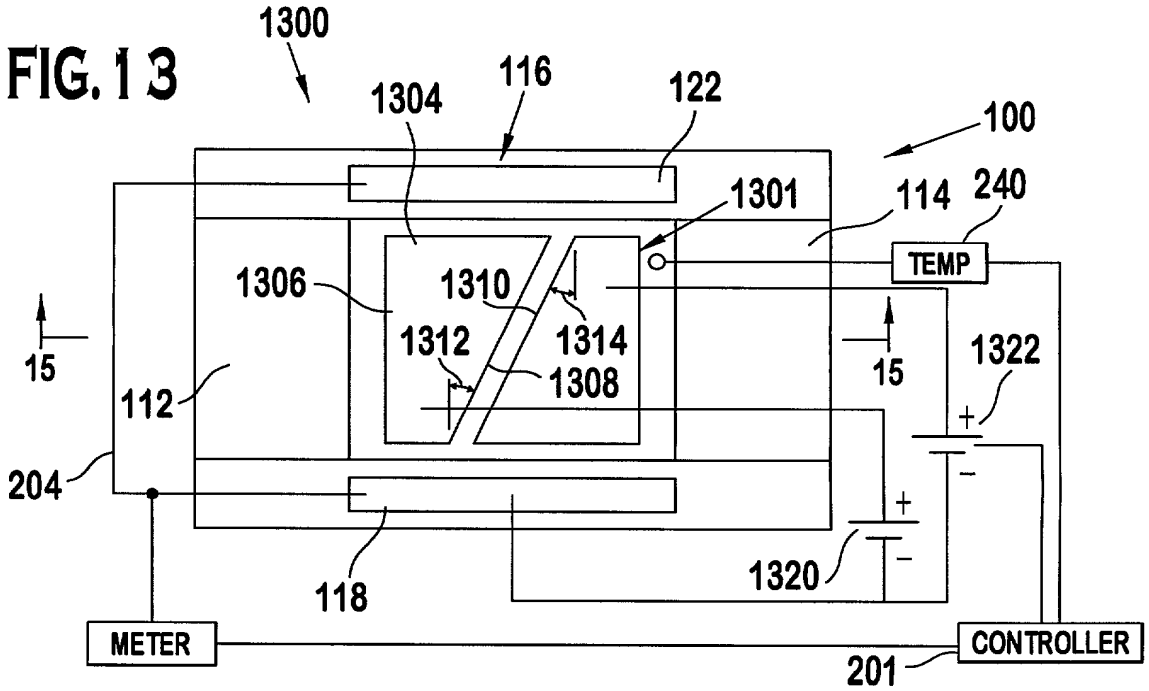



FIG. 13



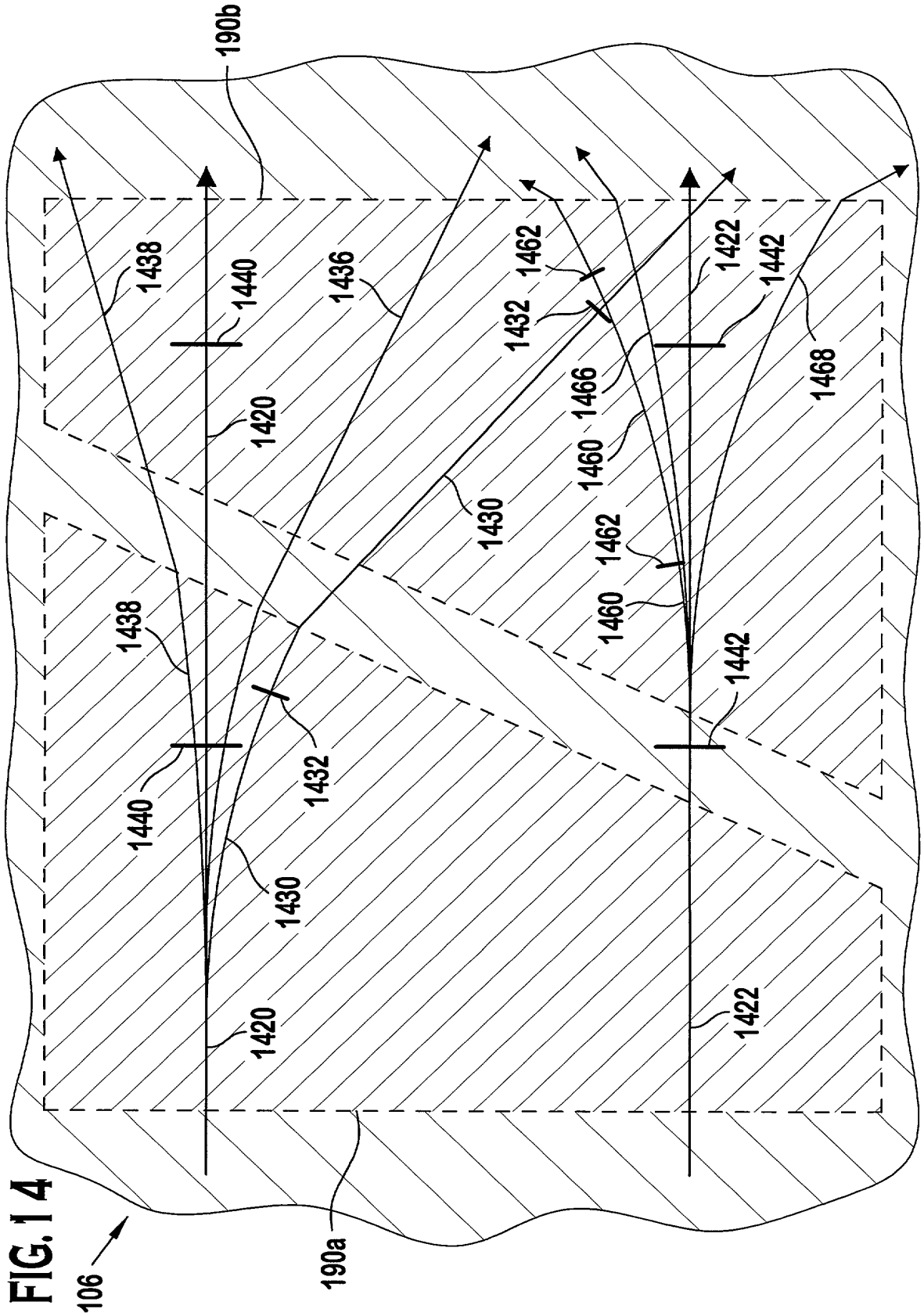

106
190a
190b
1420
1422
1430
1432
1436
1438
1440
1442
1460
1462
1466
1468

FIG. 14

FIG. 15A

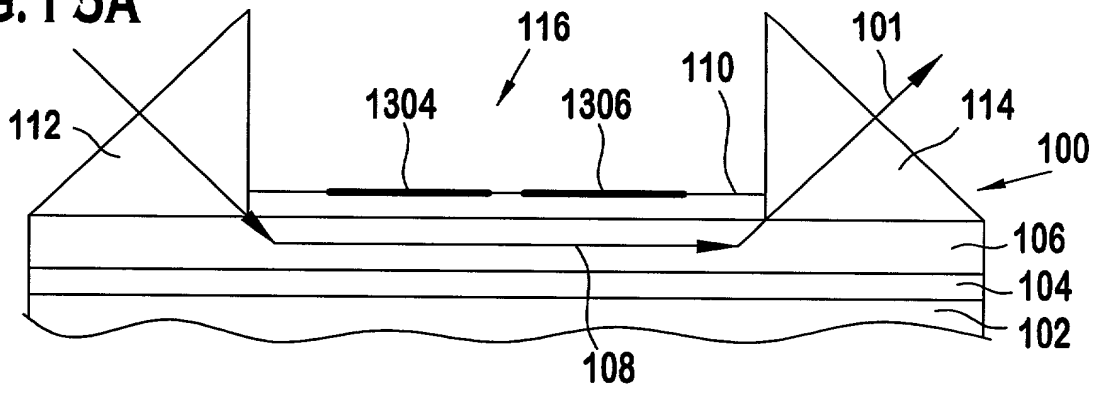



FIG. 15B

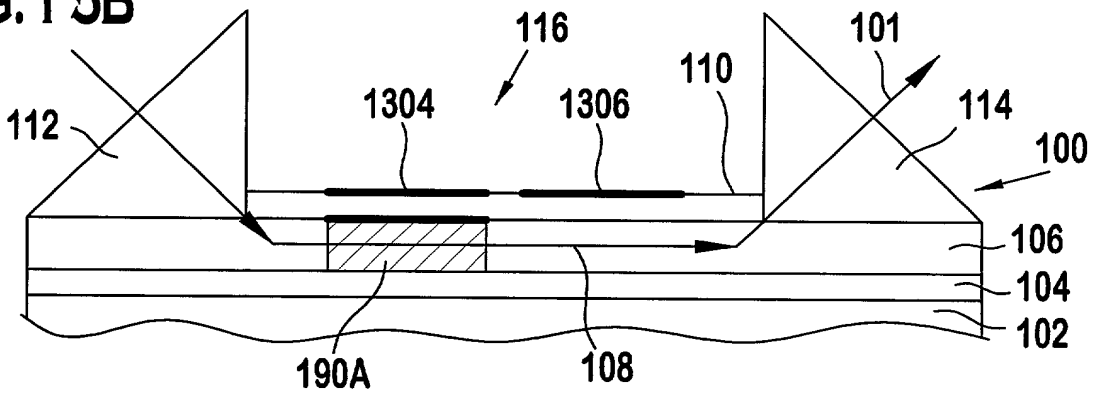



FIG. 15C

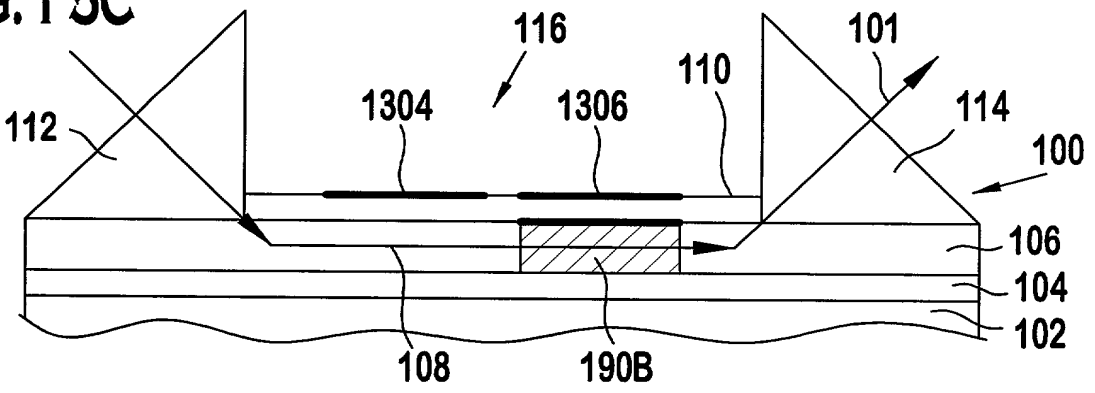



FIG. 15D

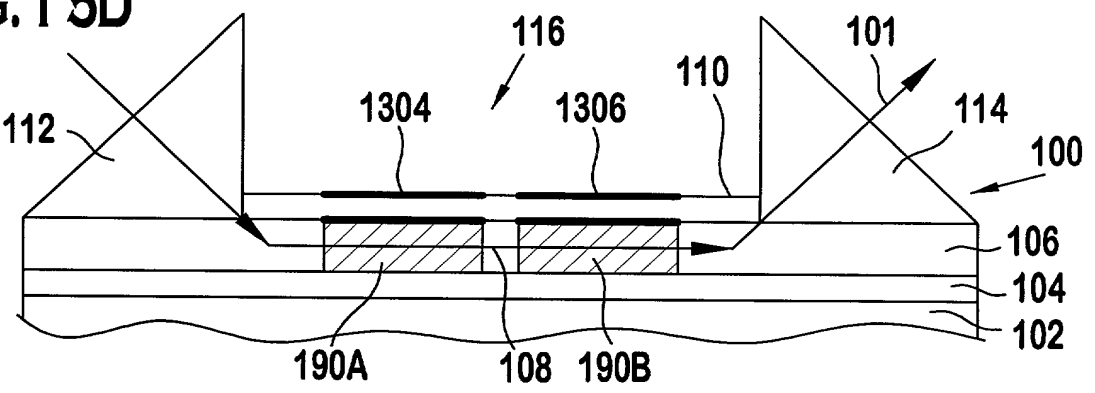


FIG. 16

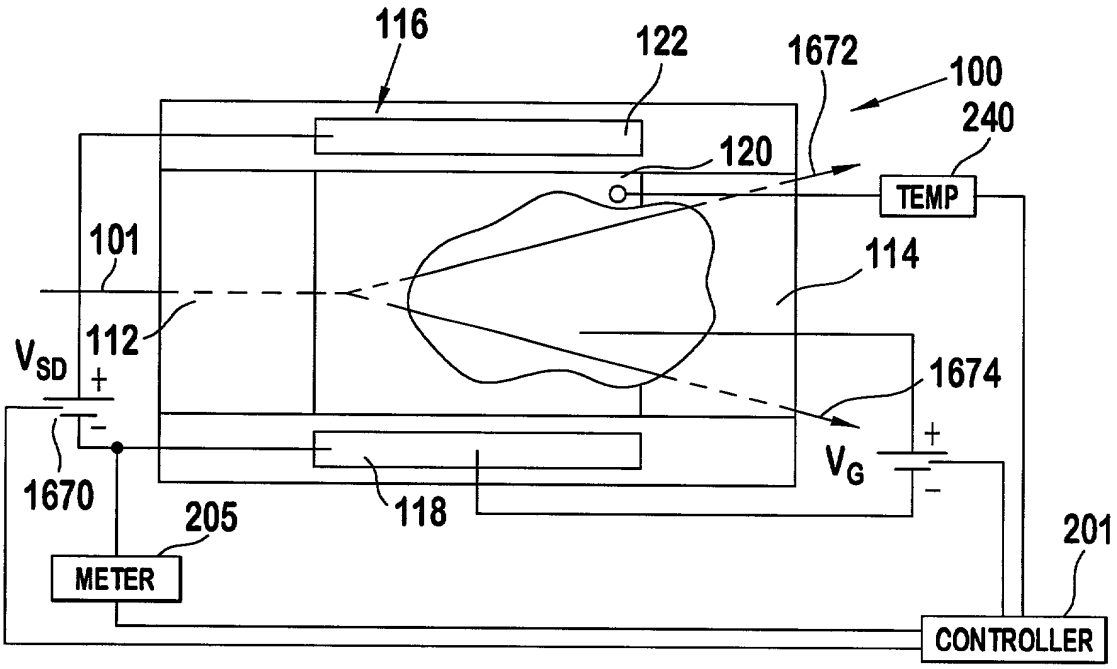

116
122
1672
100
240
120
TEMP
101
114
112
$V_{SD}$
+
1674
+
$V_G$
1670
118
205
METER
201
CONTROLLER

FIG. 17

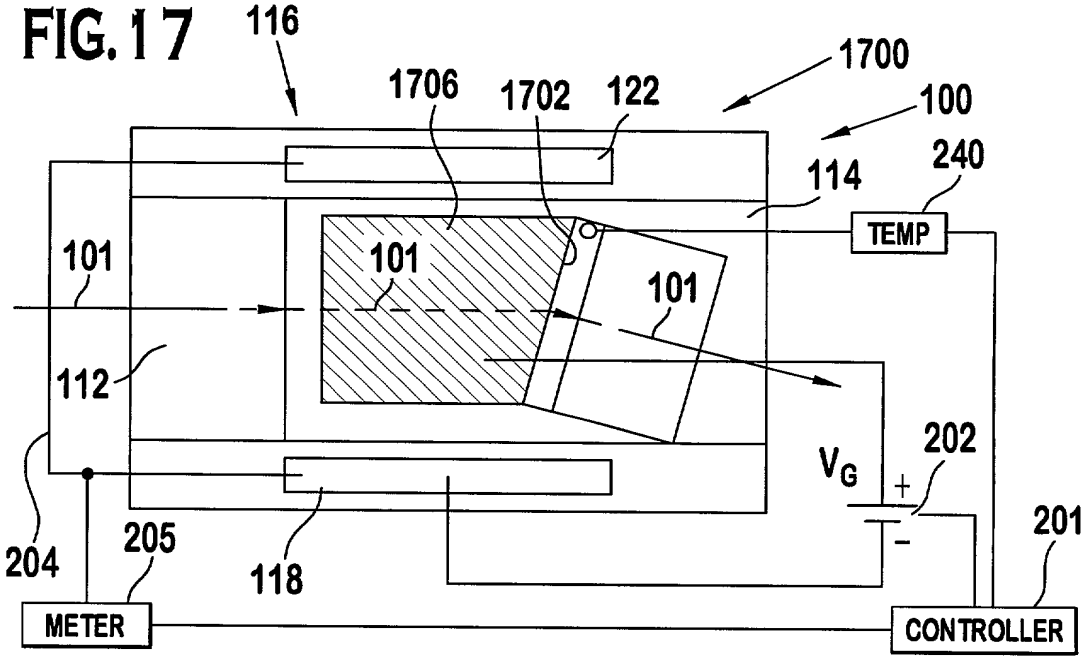

116
1700
1706
1702
122
100
114
240
TEMP
101
101
101
112
202
$V_G$
+
204
205
118
201
METER
CONTROLLER

FIG. 18

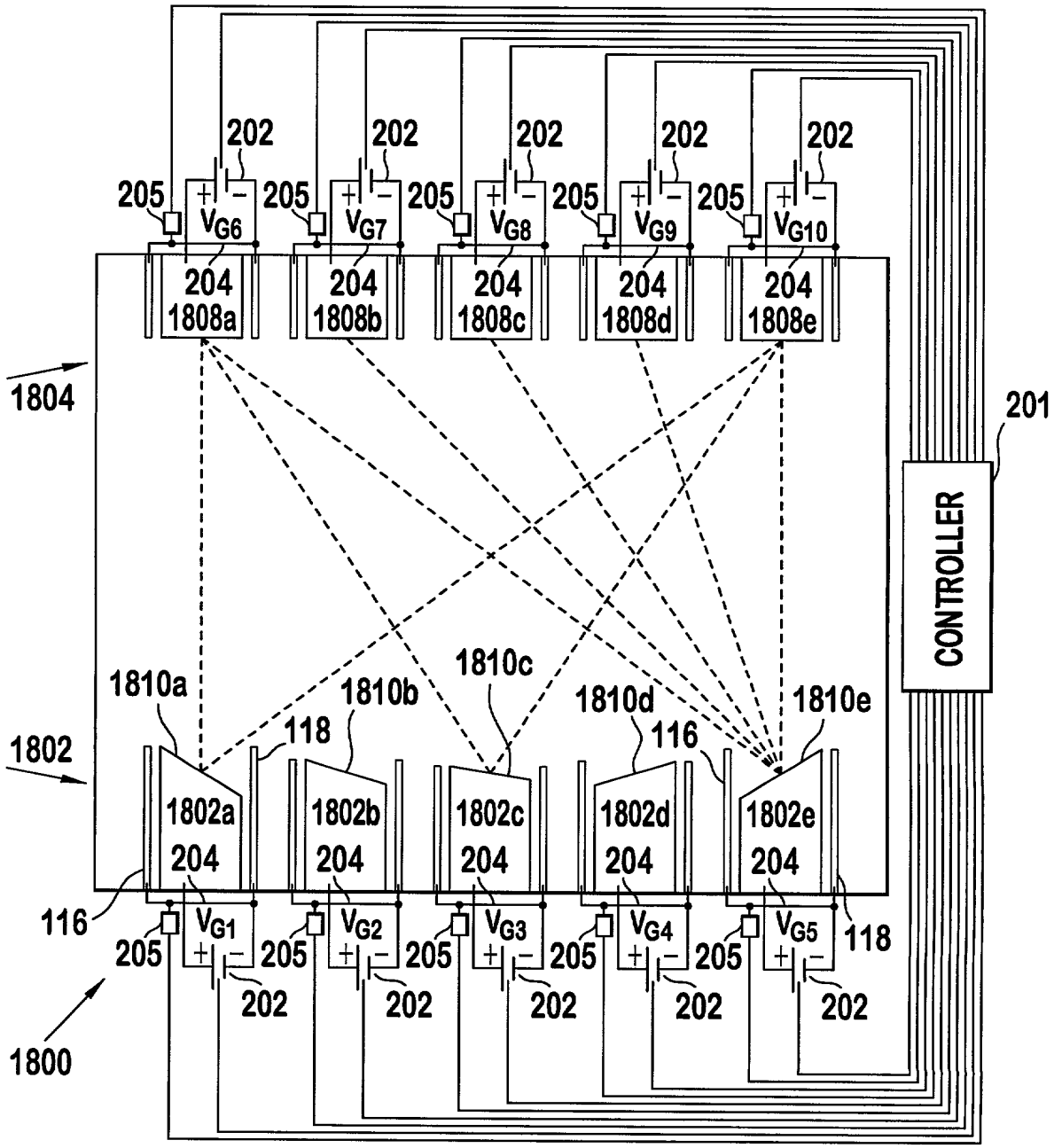

202
205
$V_{G6}$
$V_{G7}$
$V_{G8}$
$V_{G9}$
$V_{G10}$
204
1808a
1808b
1808c
1808d
1808e
1804
201
CONTROLLER
1810a
1810b
1810c
1810d
1810e
118
116
1802
1802a
1802b
1802c
1802d
1802e
$V_{G1}$
$V_{G2}$
$V_{G3}$
$V_{G4}$
$V_{G5}$
1800

FIG. 19

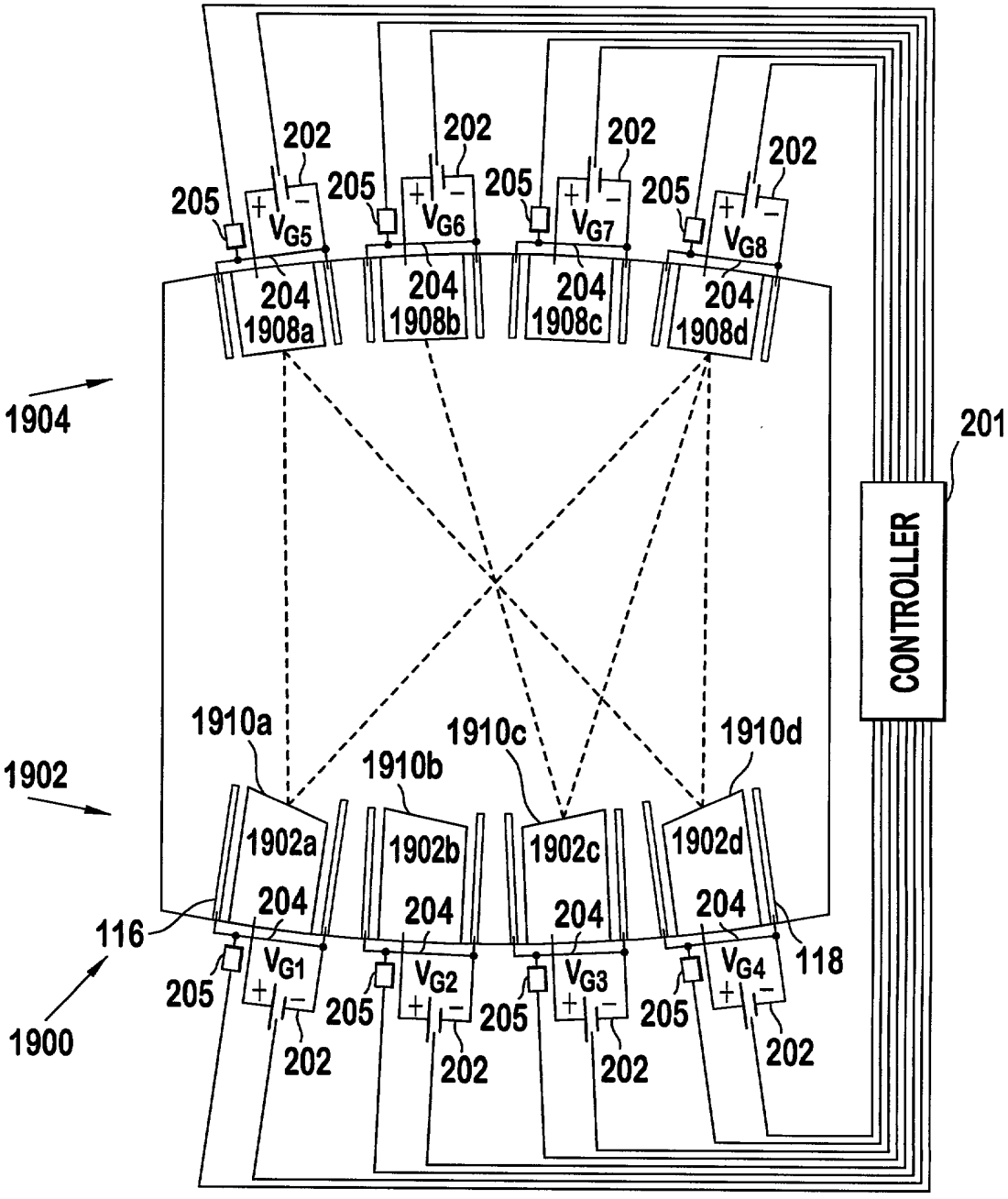

202
205
$V_{G5}$
$V_{G6}$
$V_{G7}$
$V_{G8}$
204
1908a
1908b
1908c
1908d
1904
201
CONTROLLER
1910a
1910b
1910c
1910d
1902
1902a
1902b
1902c
1902d
116
118
$V_{G1}$
$V_{G2}$
$V_{G3}$
$V_{G4}$
1900

FIG. 20

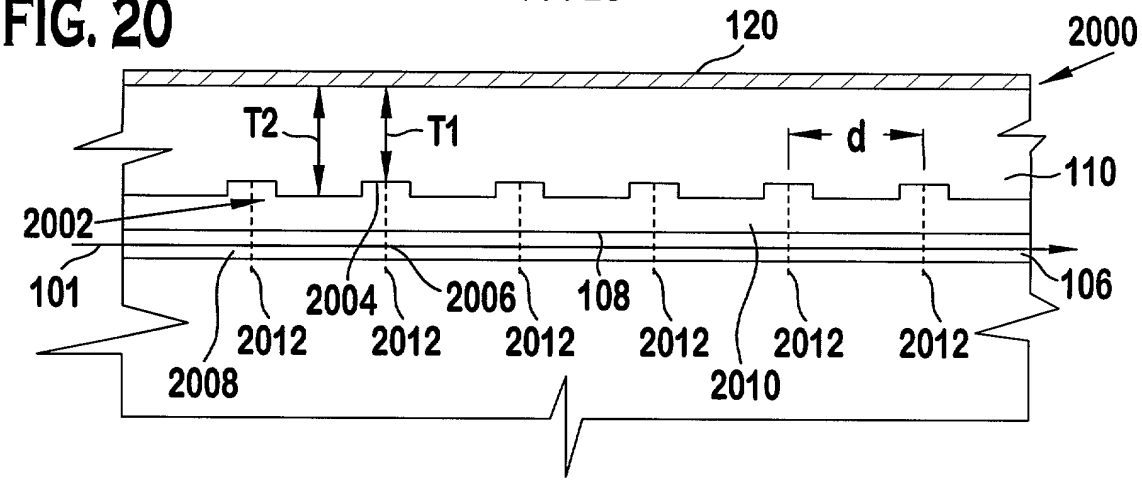



FIG. 21

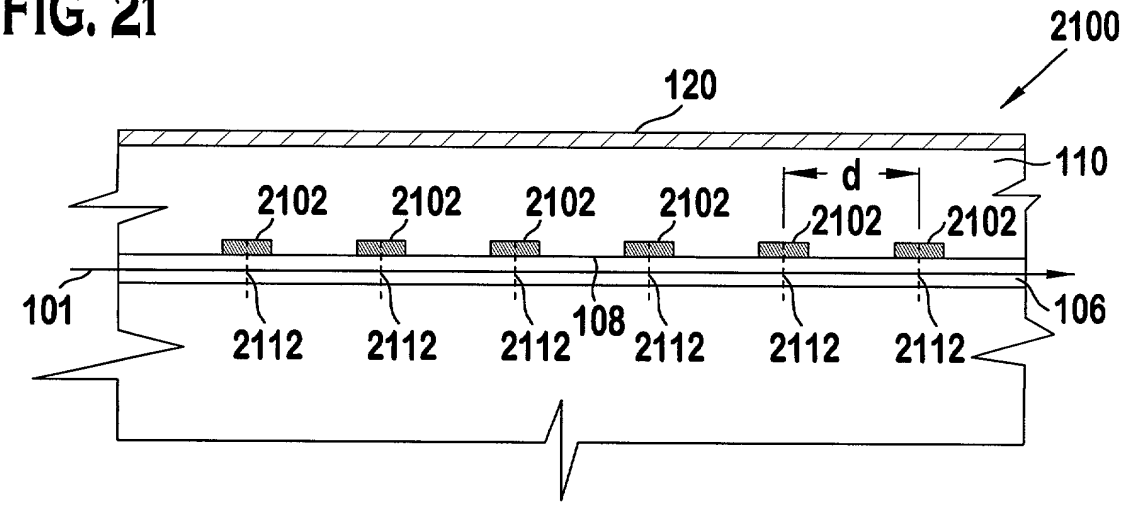



FIG. 22

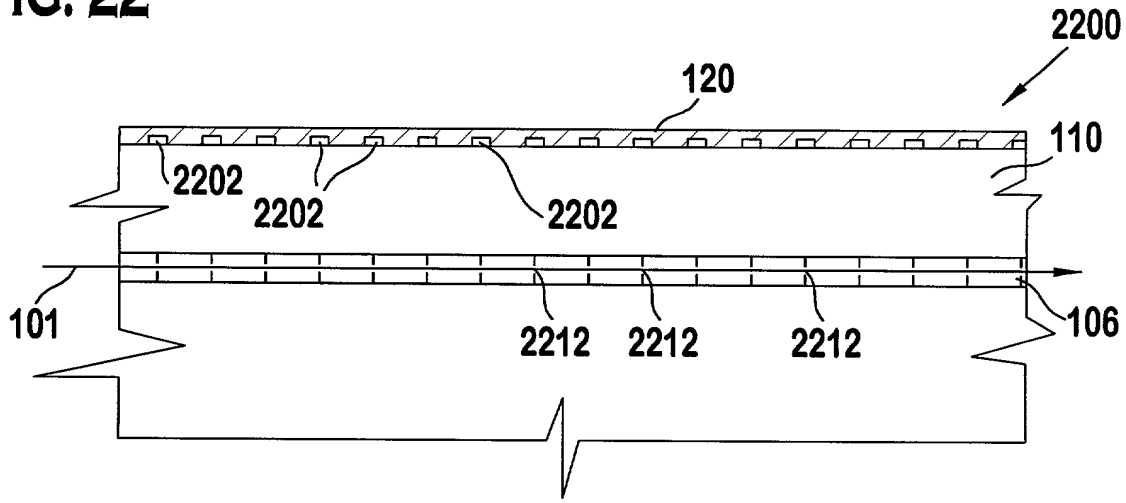


FIG. 23

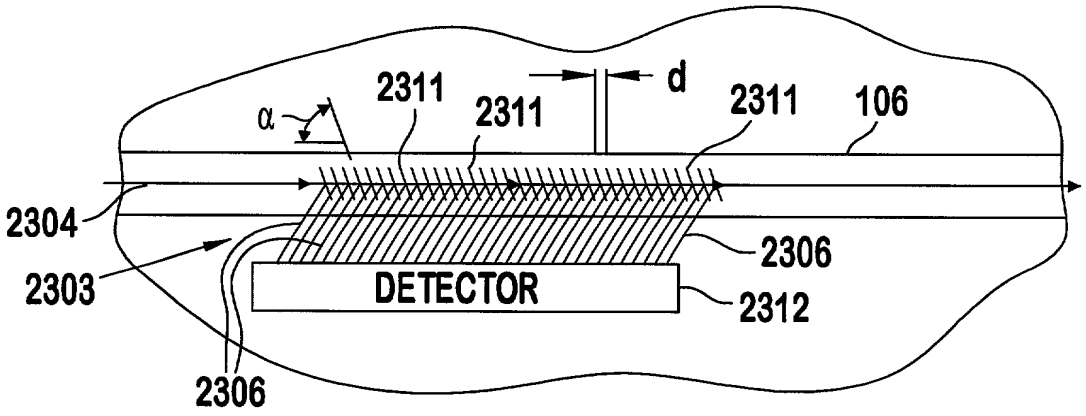

α
2311
2311
d
2311
106
2304
2303
DETECTOR
2306
2312
2306

FIG. 24

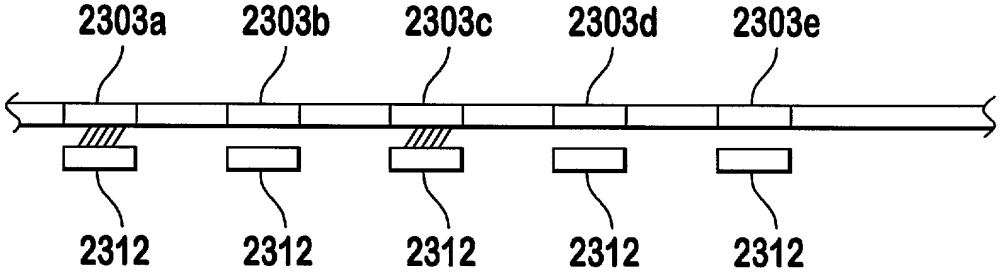

2303a
2303b
2303c
2303d
2303e
2312
2312
2312
2312
2312

FIG. 25

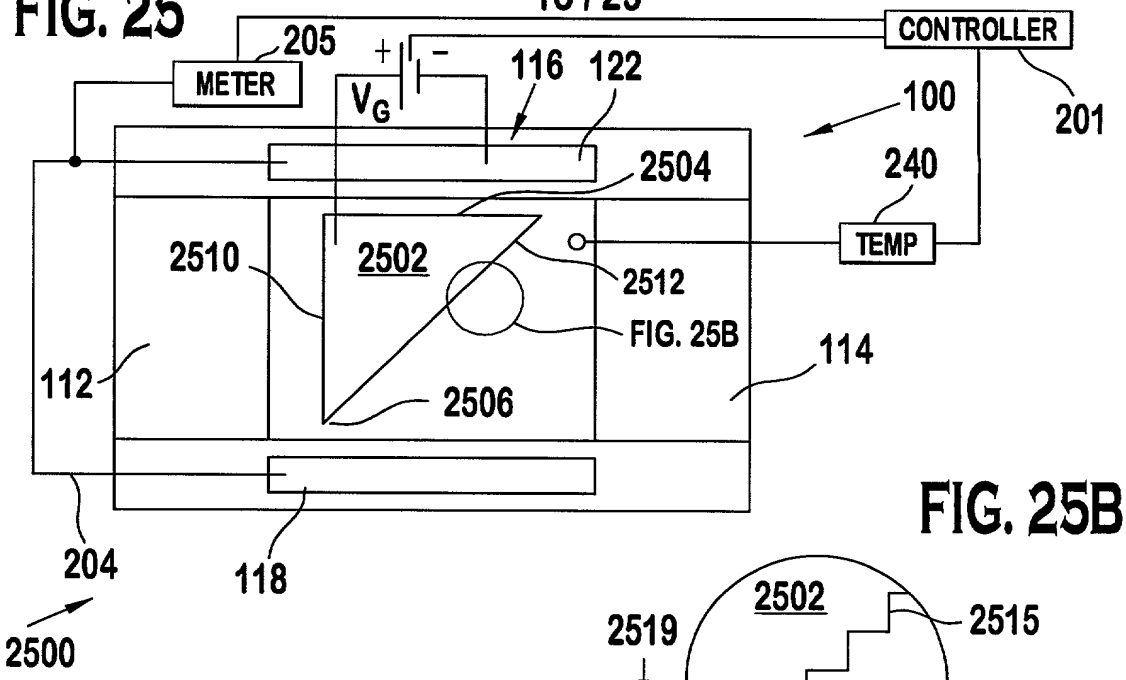



FIG. 25B

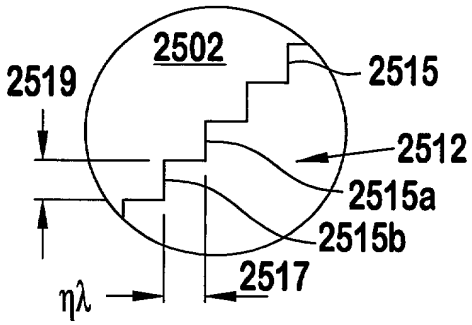



FIG. 26

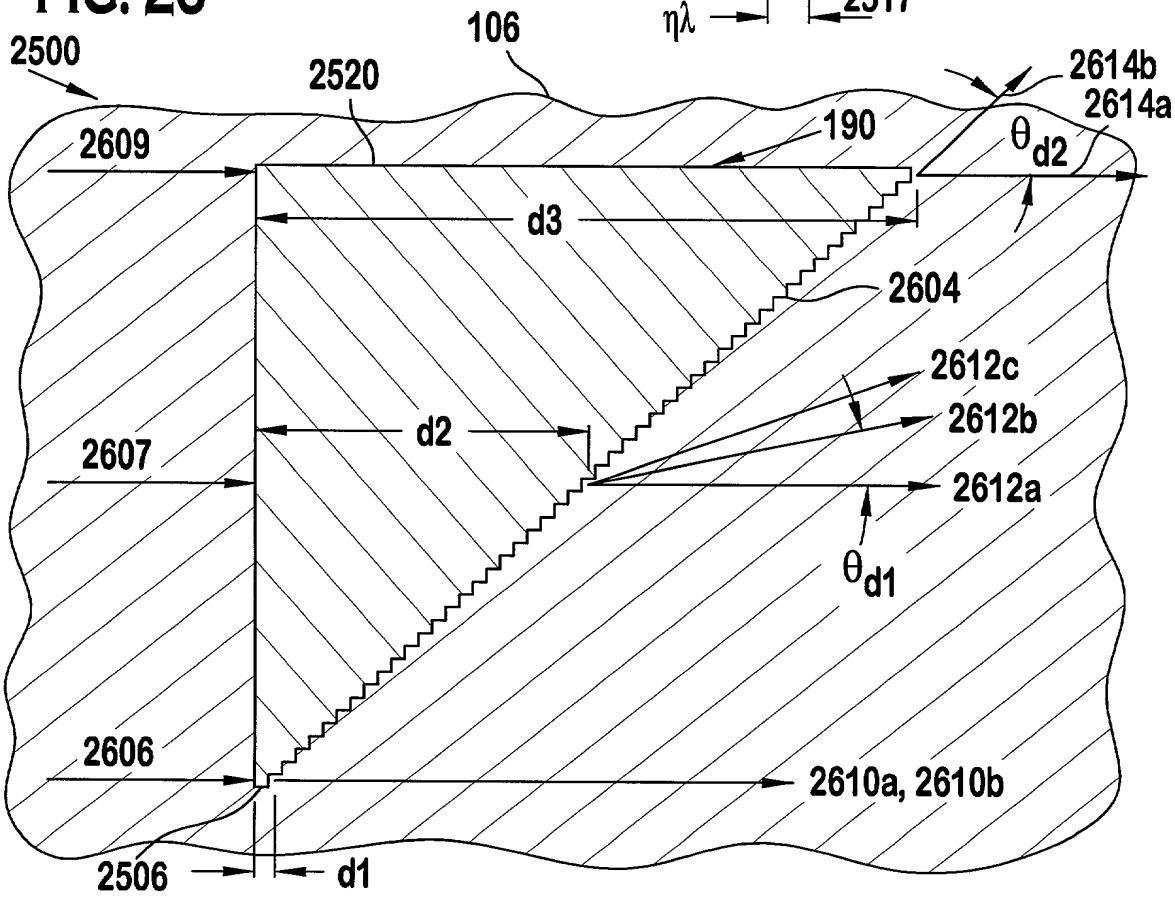


FIG. 27

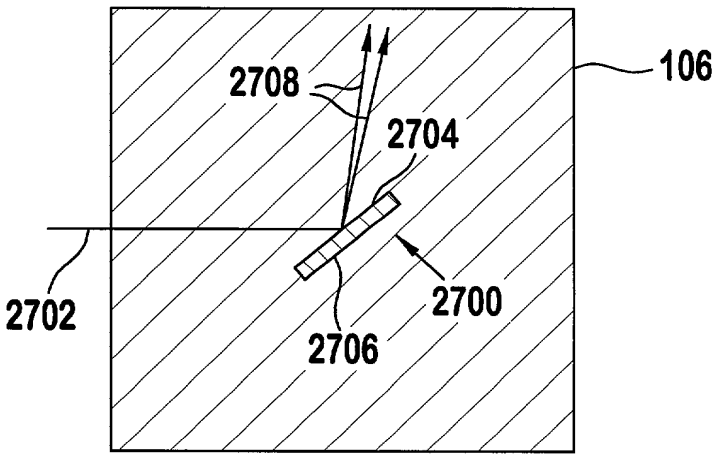



FIG. 28

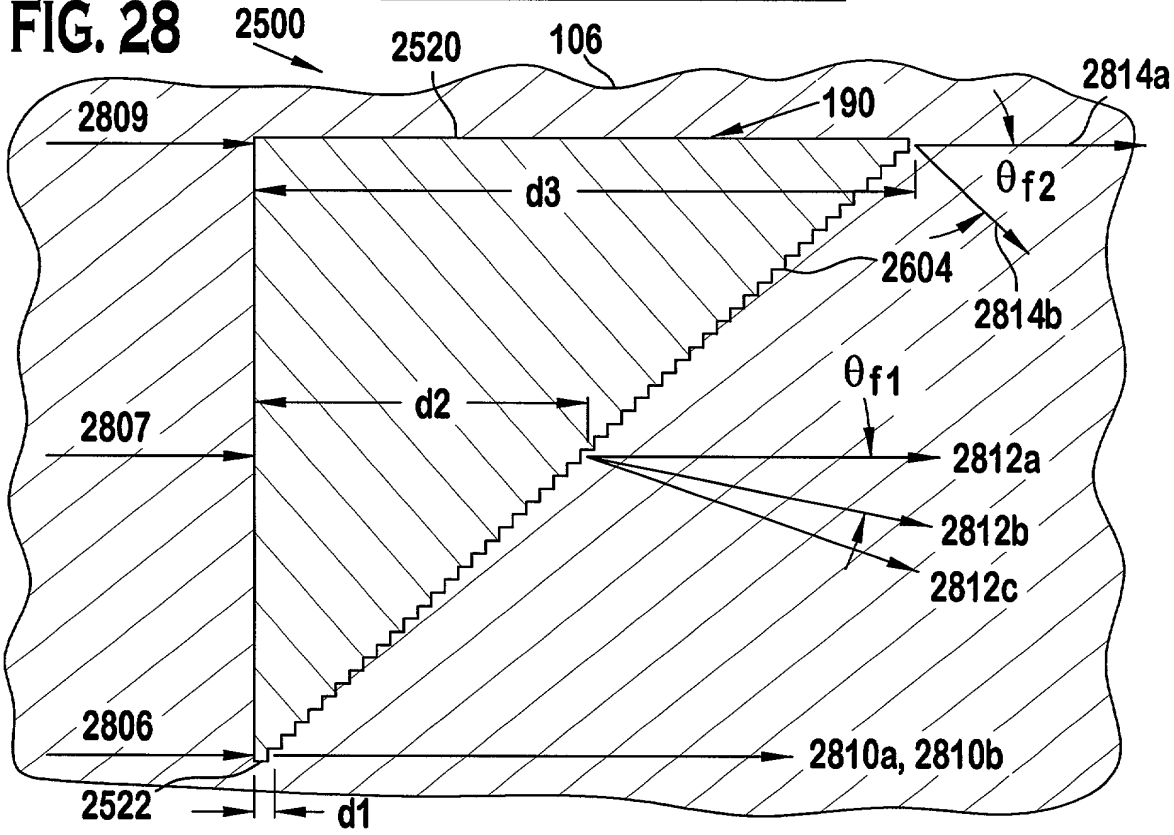



FIG. 29

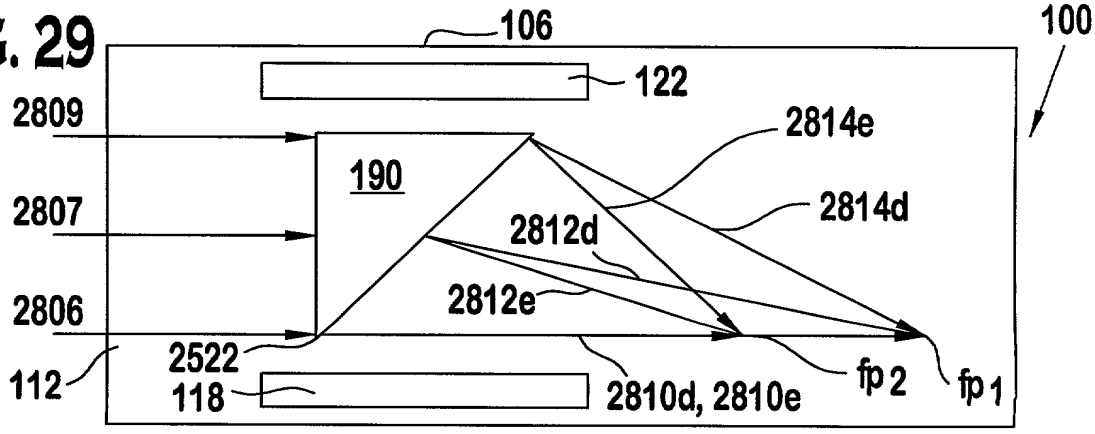


FIG. 30

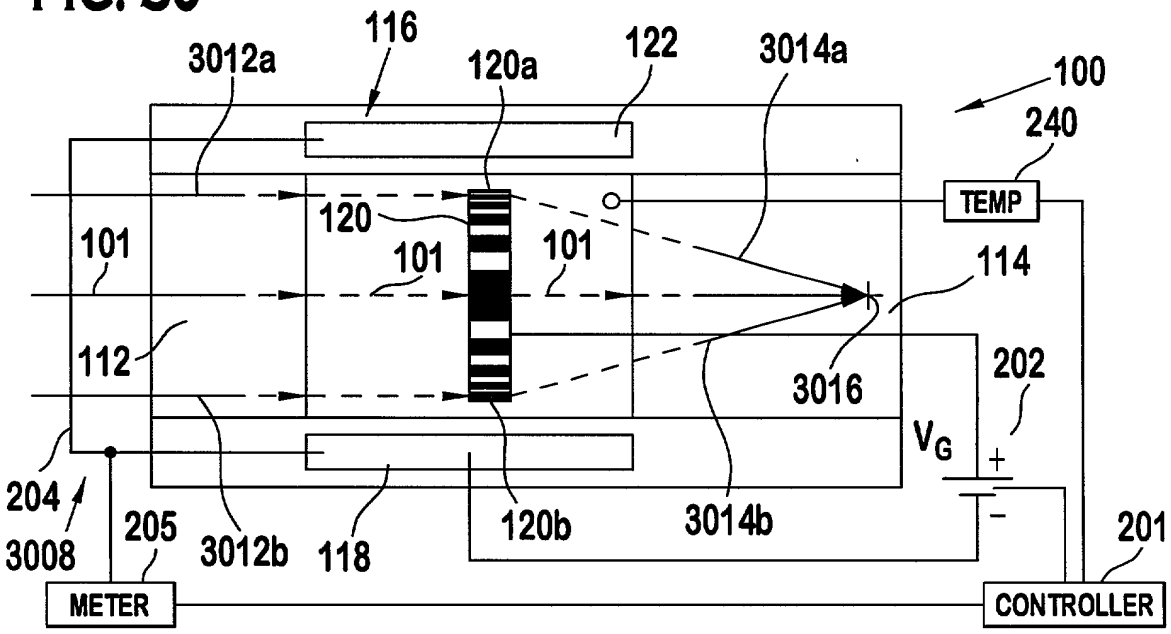



FIG. 30A

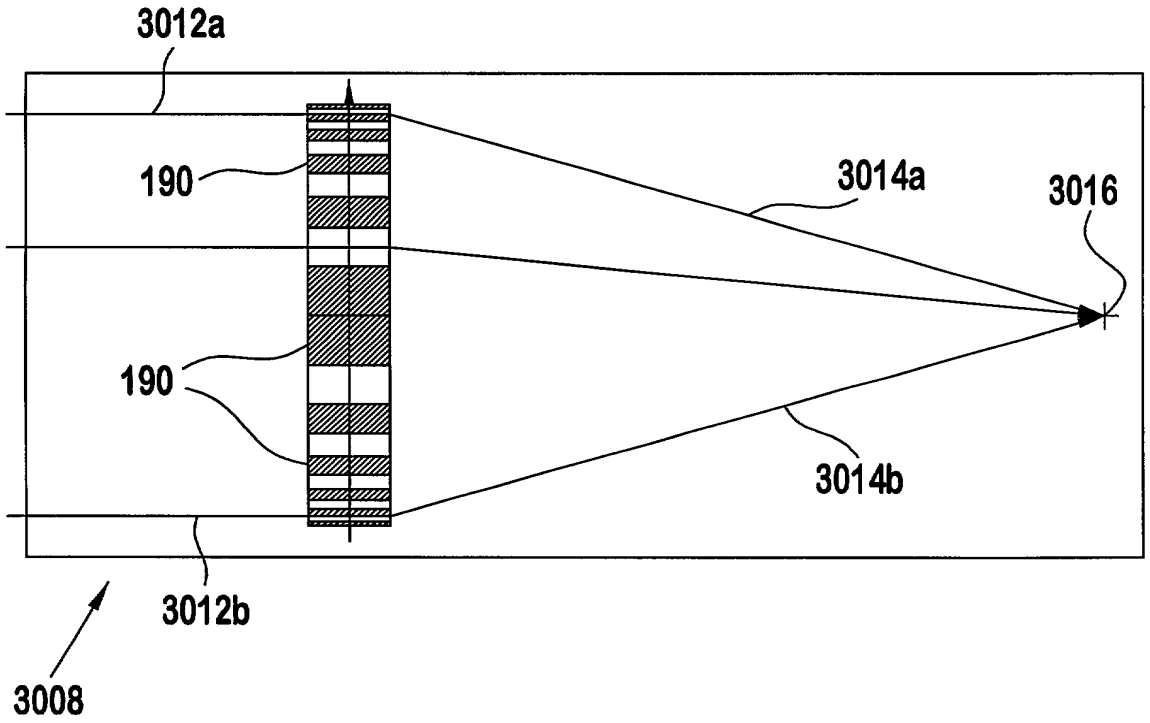


FIG. 31

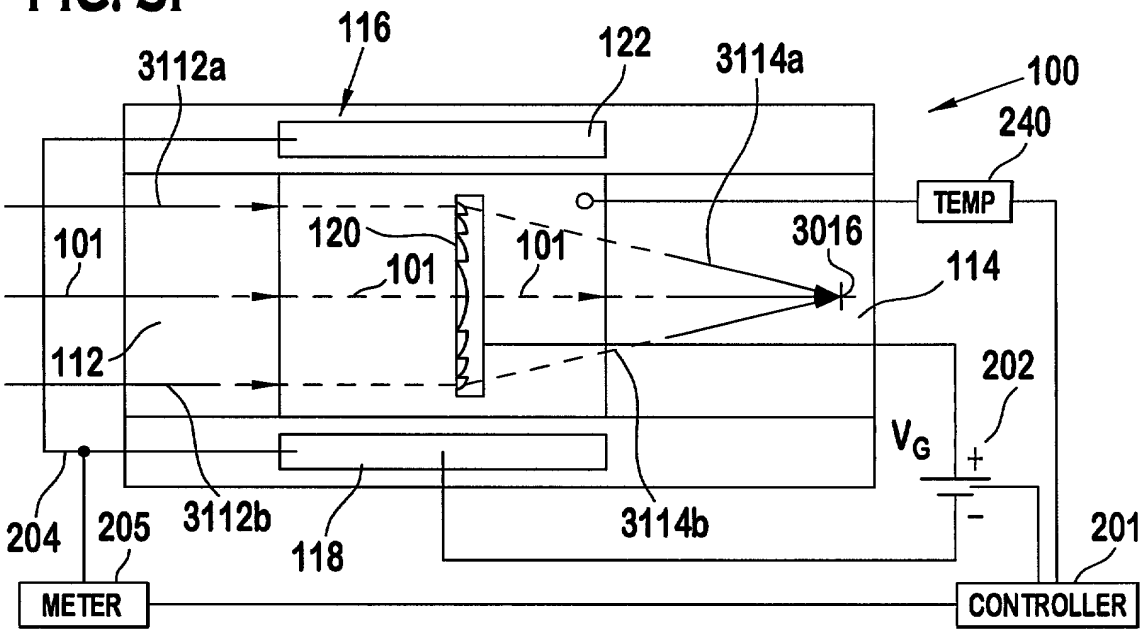



FIG. 31 A

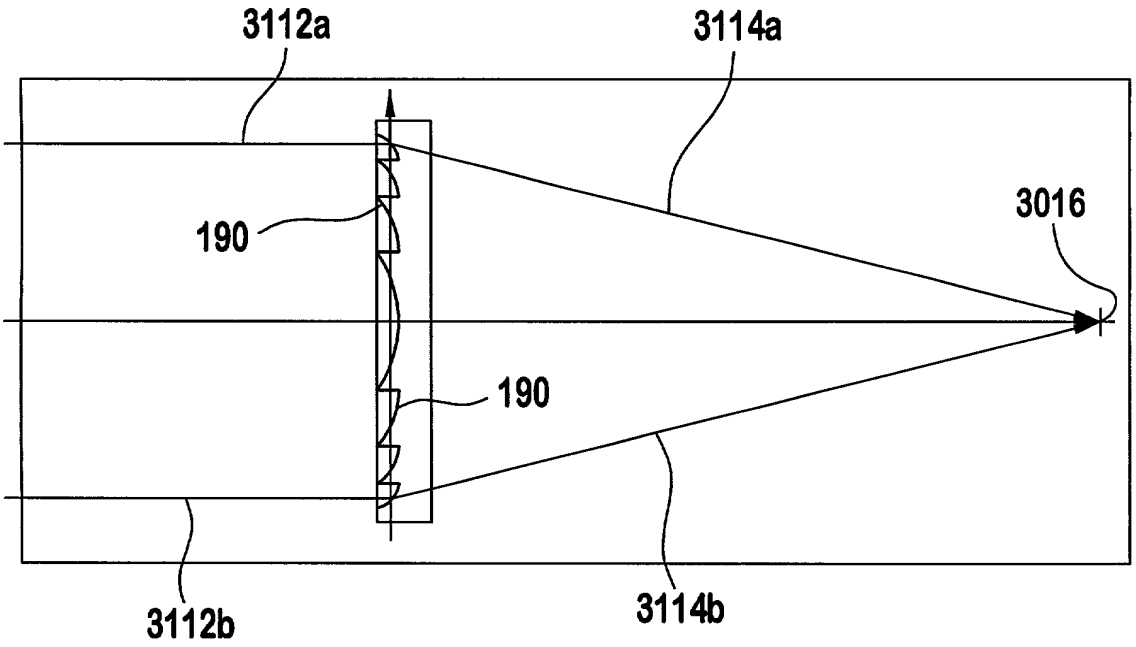


FIG. 32

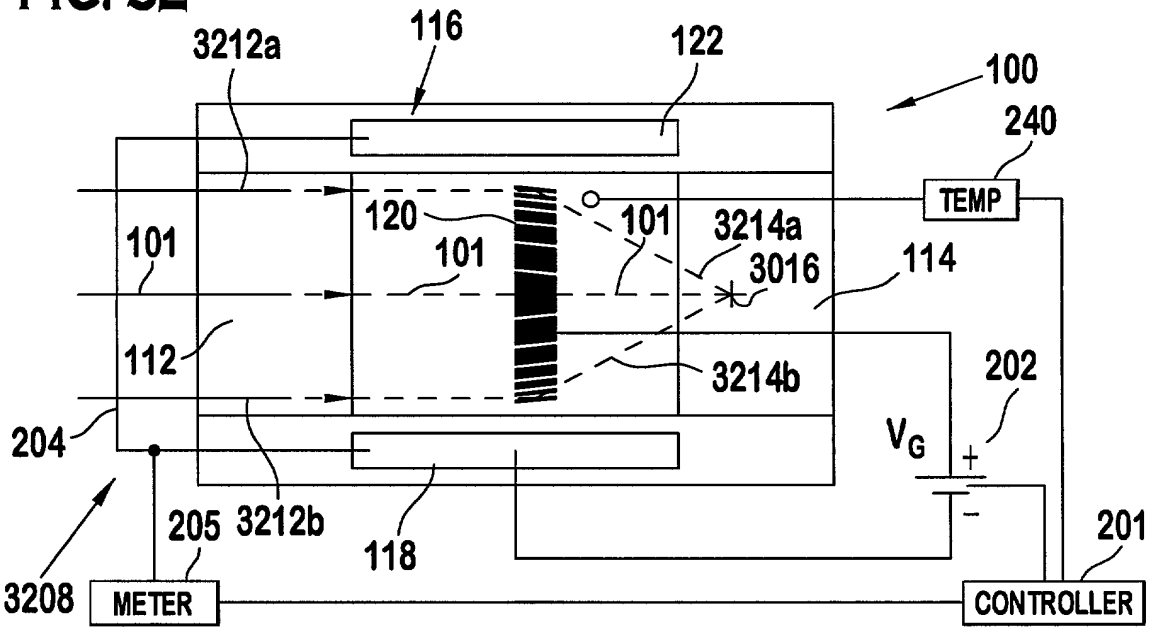



FIG. 32A

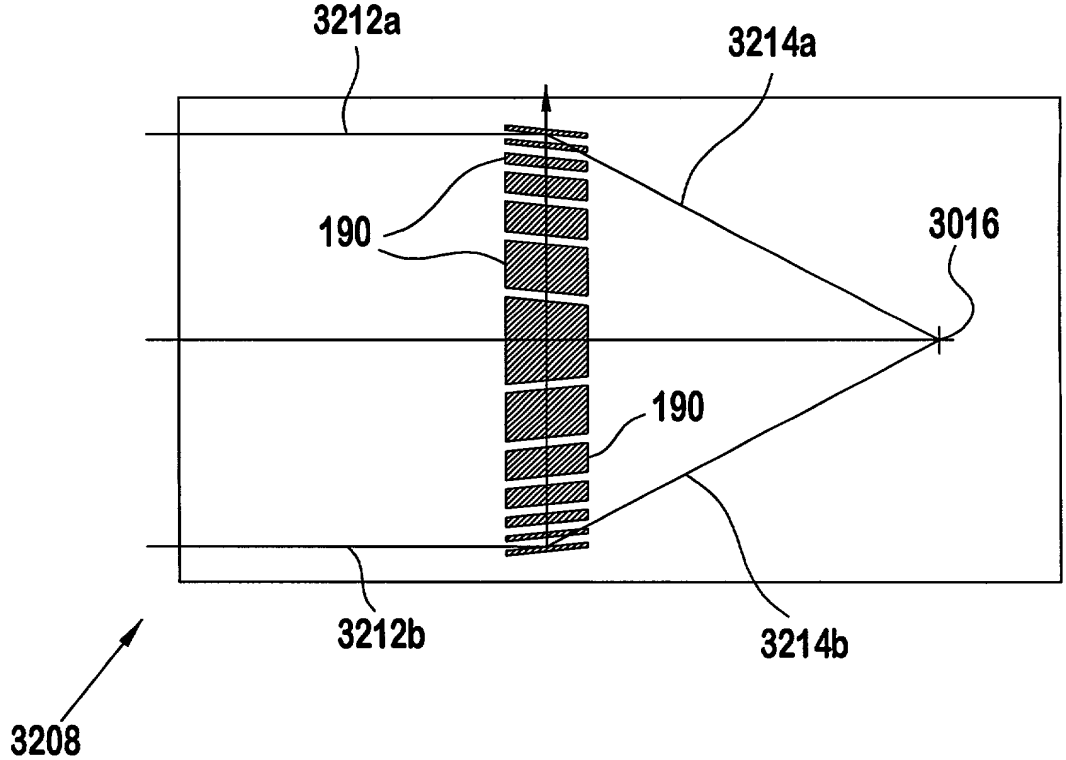


FIG. 33

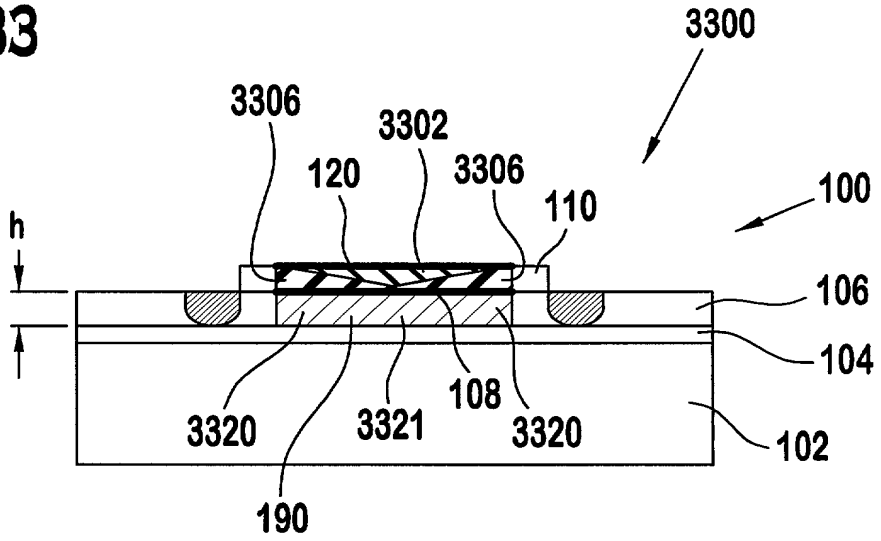

3300
3306
3302
120
3306
110
100
h
106
104
108
3320
3321
3320
102
190

FIG. 34

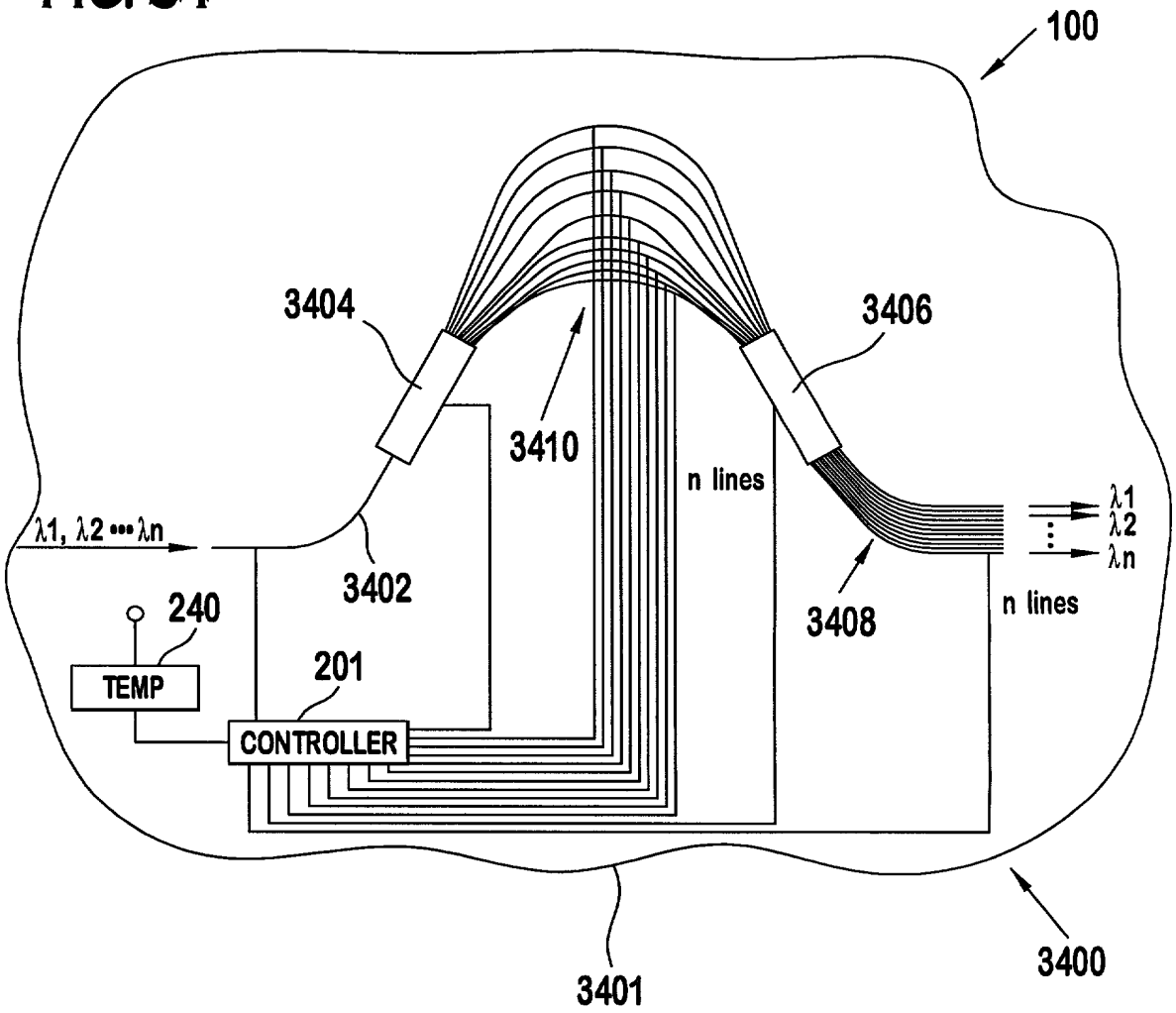

100
3404
3406
3410
n lines
λ1, λ2 ••• λn
3402
3408
n lines
λ1
λ2
λn
240
TEMP
201
CONTROLLER
3401
3400

FIG. 35

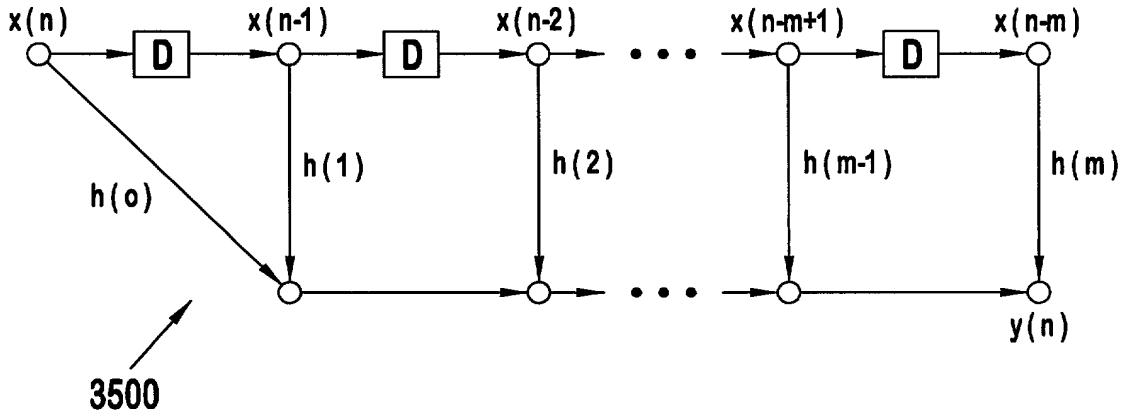

x(n)
D
x(n-1)
D
x(n-2)
x(n-m+1)
D
x(n-m)
h(o)
h(1)
h(2)
h(m-1)
h(m)
y(n)
3500

FIG. 36

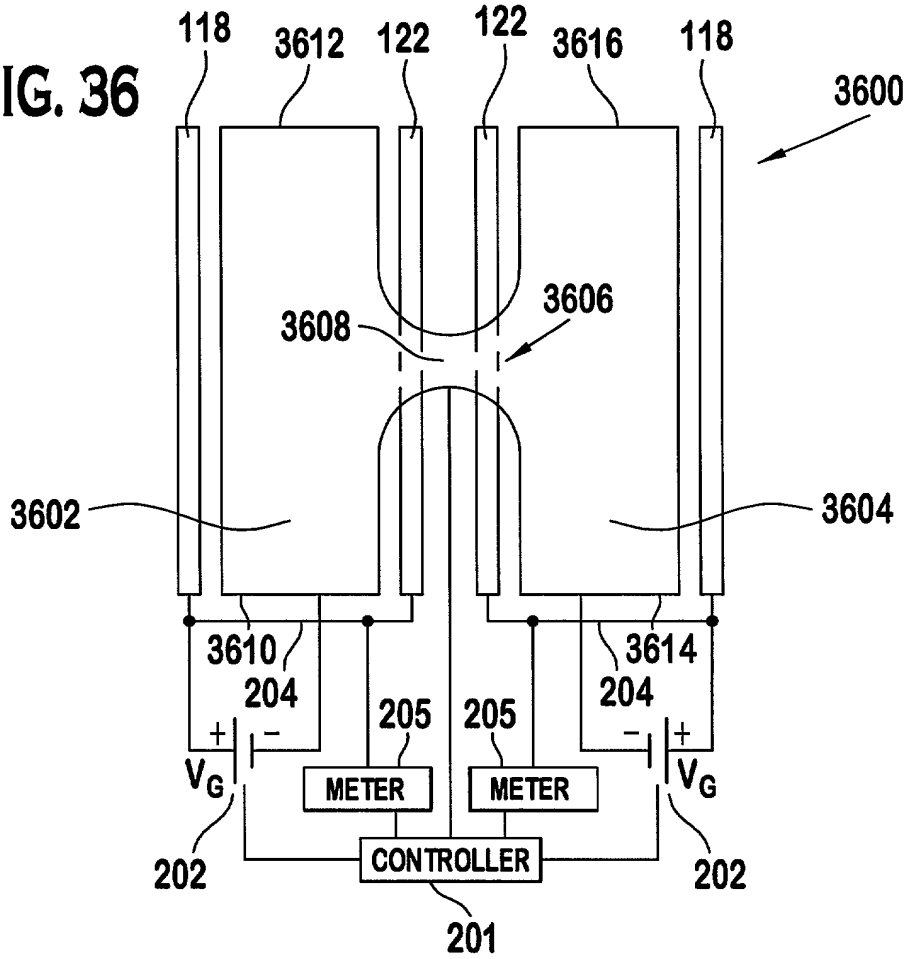

118
3612
122
122
3616
118
3600
3606
3608
3602
3604
3610
204
205
205
3614
204
METER
METER
CONTROLLER
$V_G$
$V_G$
202
202
201

FIG. 37

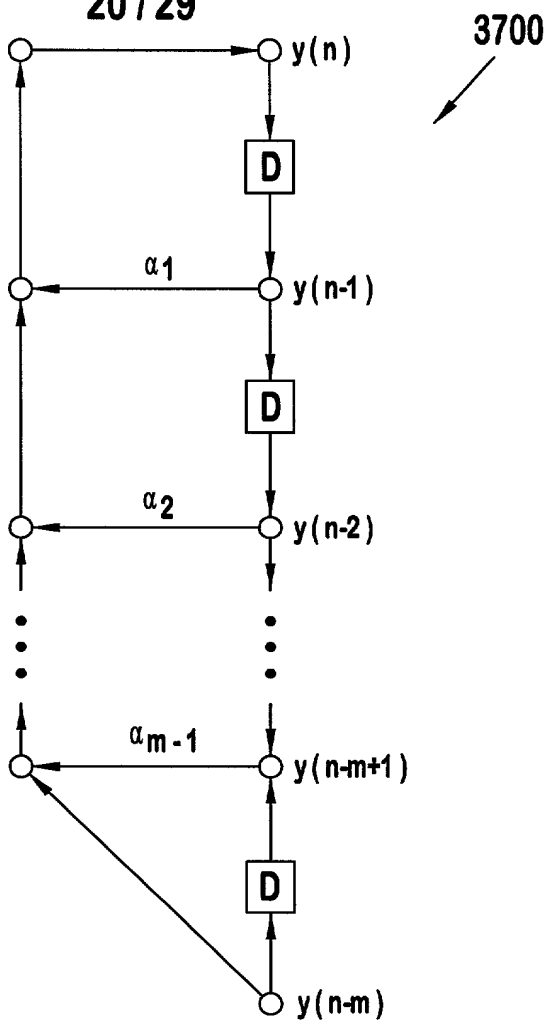

3700
y(n)
D
α1
y(n-1)
D
α2
y(n-2)
αm-1
y(n-m+1)
D
y(n-m)

FIG. 38

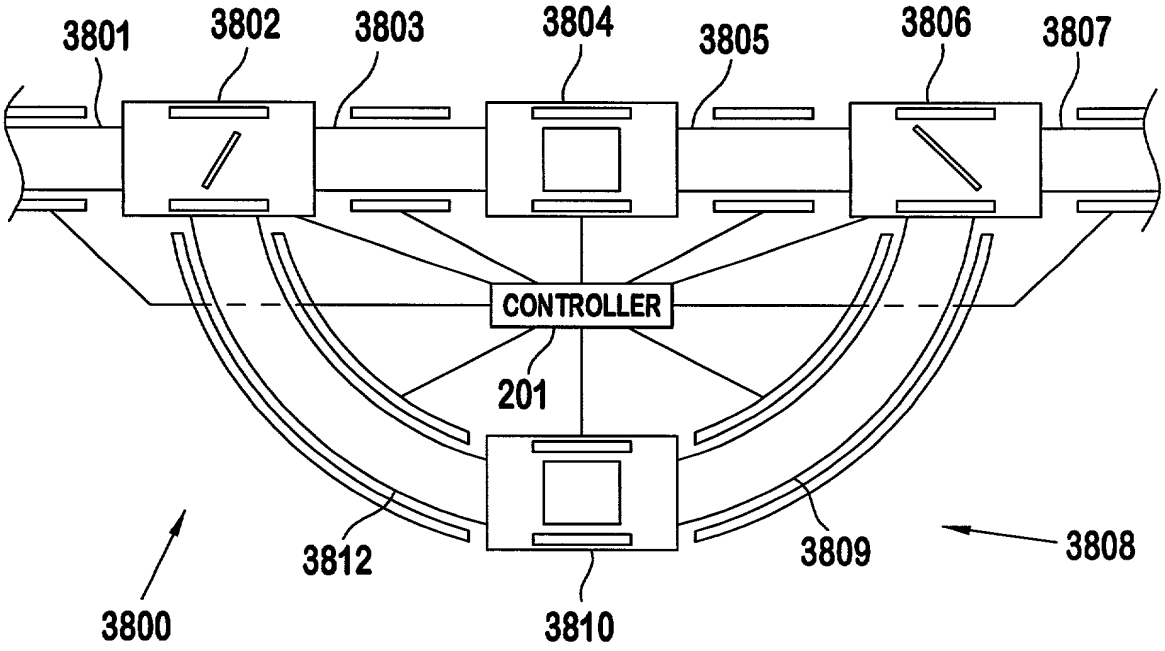

3801
3802
3803
3804
3805
3806
3807
CONTROLLER
201
3800
3812
3810
3809
3808

FIG. 39

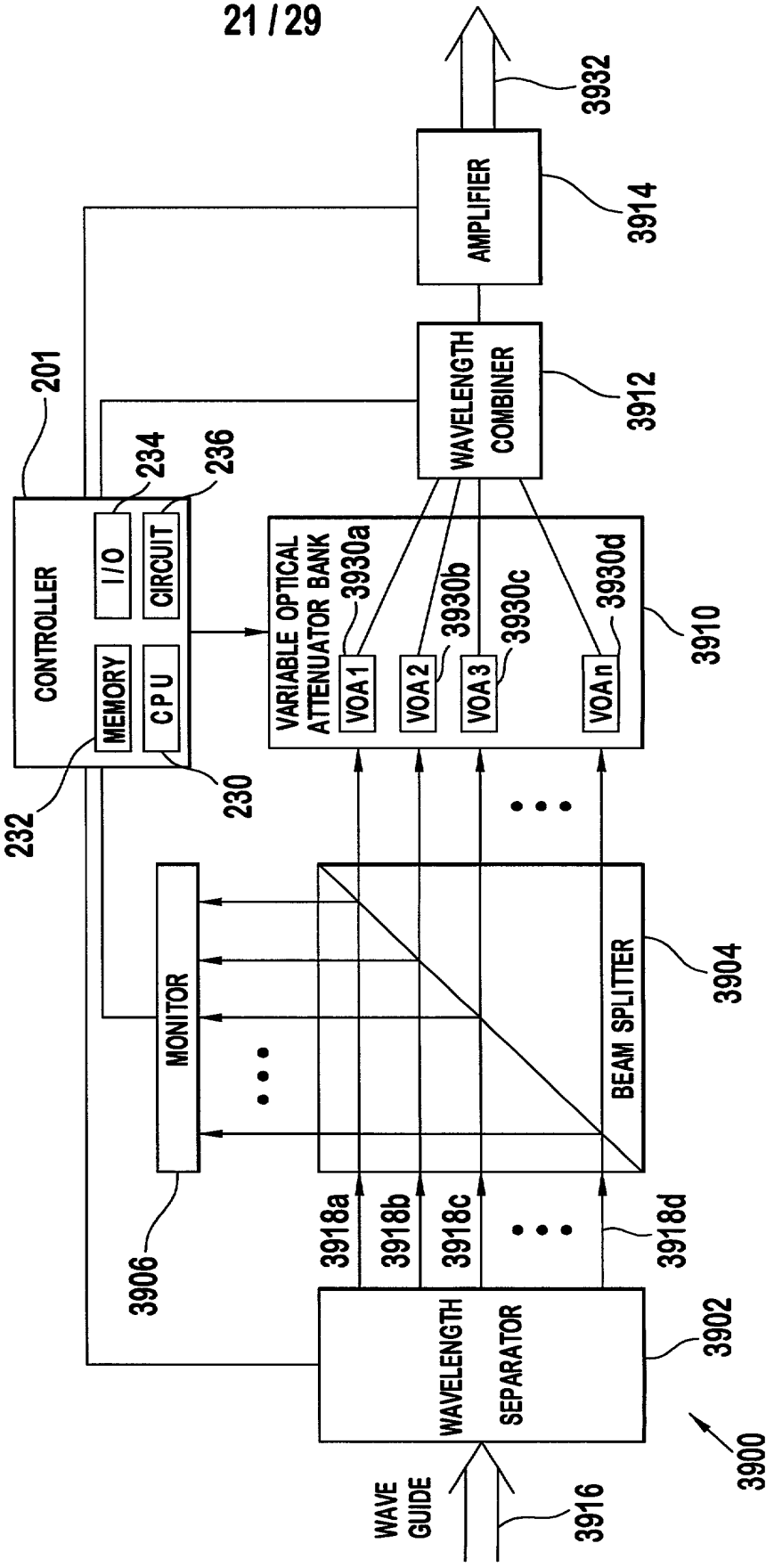
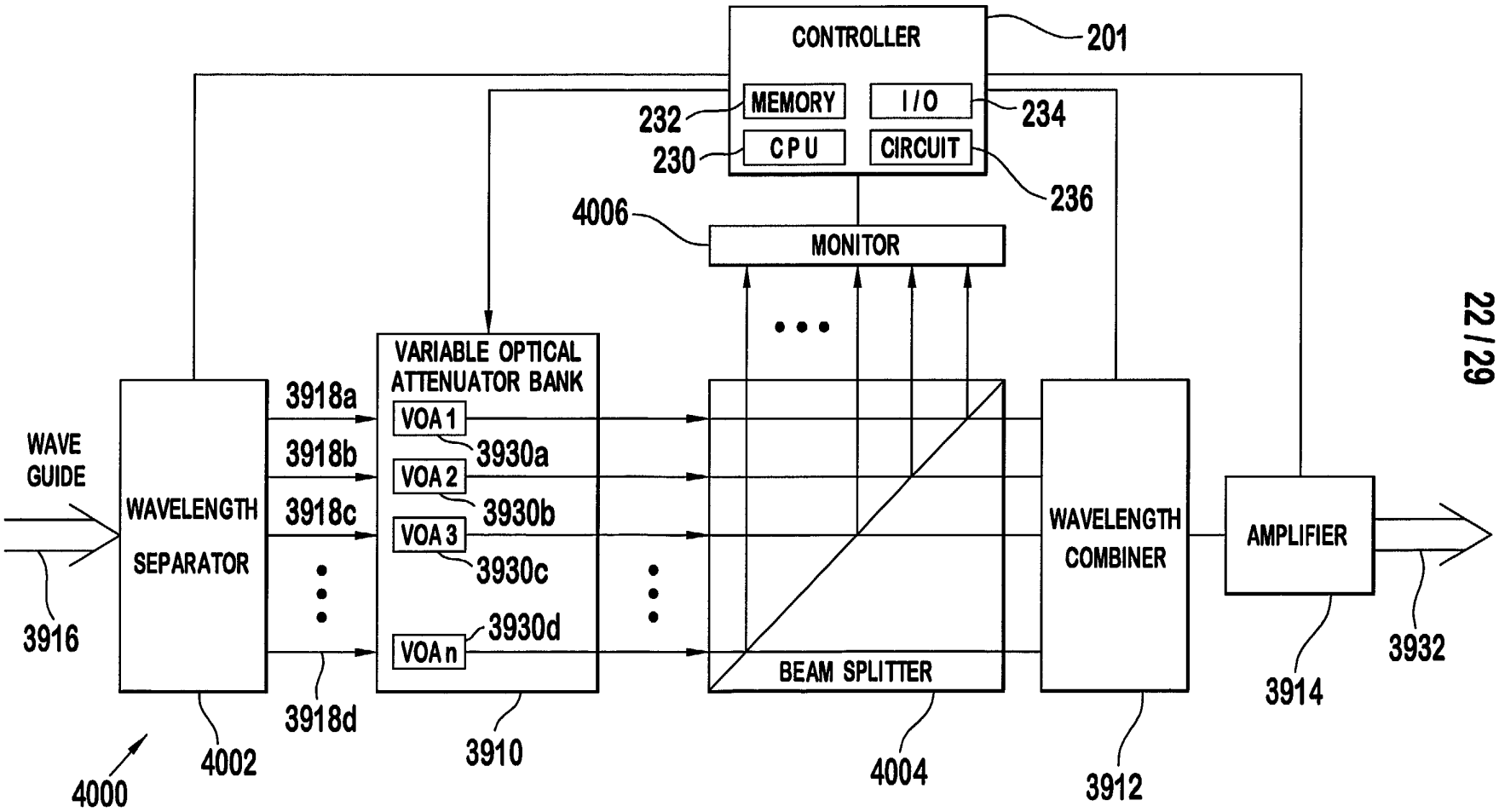

3900
WAVE GUIDE
3916
WAVELENGTH SEPARATOR
3902
3918a
3918b
3918c
3918d
MONITOR
3906
BEAM SPLITTER
3904
VARIABLE OPTICAL ATTENUATOR BANK
VOA1
VOA2
VOA3
VOAn
3930a
3930b
3930c
3930d
3910
WAVELENGTH COMBINER
3912
AMPLIFIER
3914
3932
CONTROLLER
201
I/O
CIRCUIT
MEMORY
CPU
234
236
232
230

FIG. 40


CONTROLLER
201
MEMORY
I/O
232
234
CPU
CIRCUIT
230
236
4006
MONITOR
VARIABLE OPTICAL ATTENUATOR BANK
3918a
VOA 1
3930a
3918b
VOA 2
3930b
3918c
VOA 3
3930c
VOA n
3930d
WAVE GUIDE
WAVELENGTH SEPARATOR
3916
3918d
4002
4000
3910
BEAM SPLITTER
4004
WAVELENGTH COMBINER
3912
AMPLIFIER
3914
3932

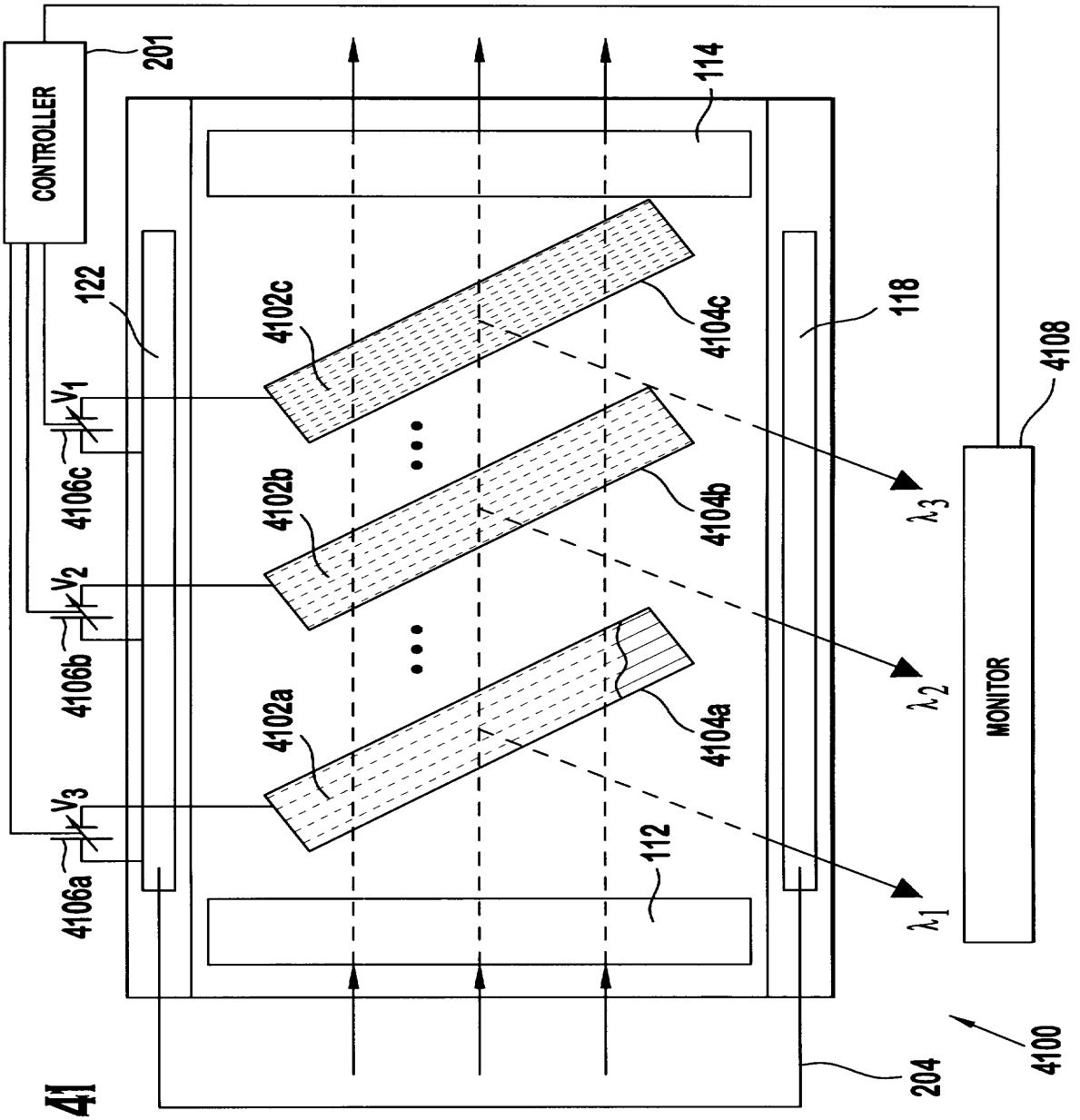

CONTROLLER
201
114
122
118
4102c
4104c
4108
V1
4106c
4102b
4104b
λ3
V2
4106b
λ2
MONITOR
4102a
4104a
V3
112
λ1
4106a
204
4100

FIG. 41

FIG. 42

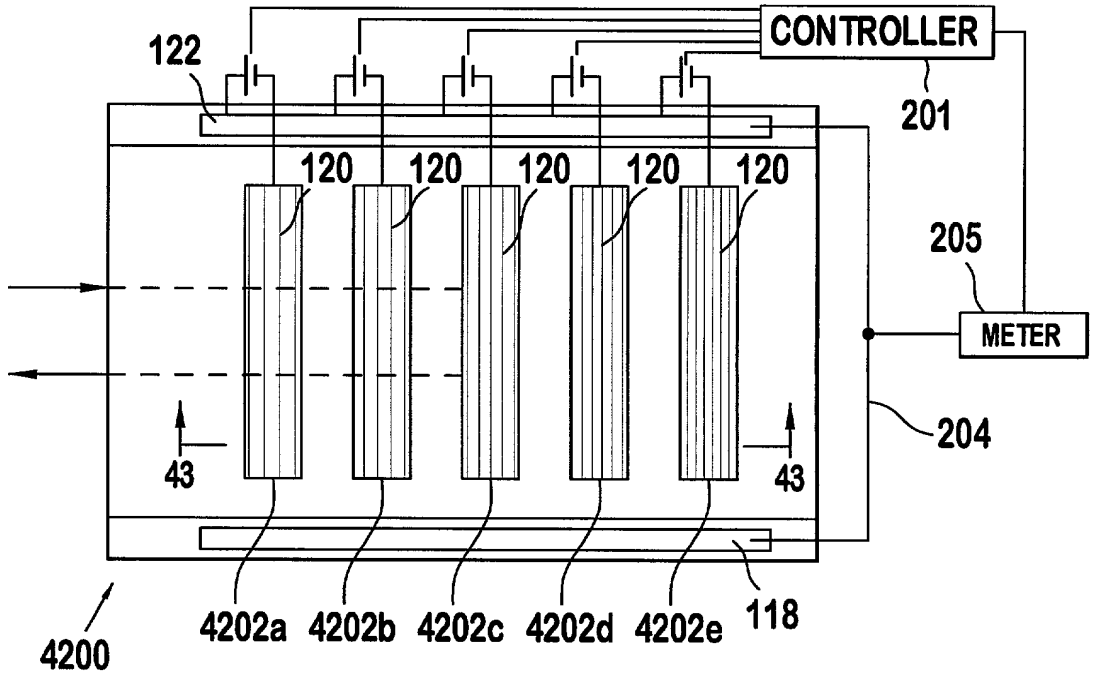

CONTROLLER
122
201
120
120
120
120
120
205
METER
204
43
43
4200
4202a
4202b
4202c
4202d
4202e
118

FIG. 43

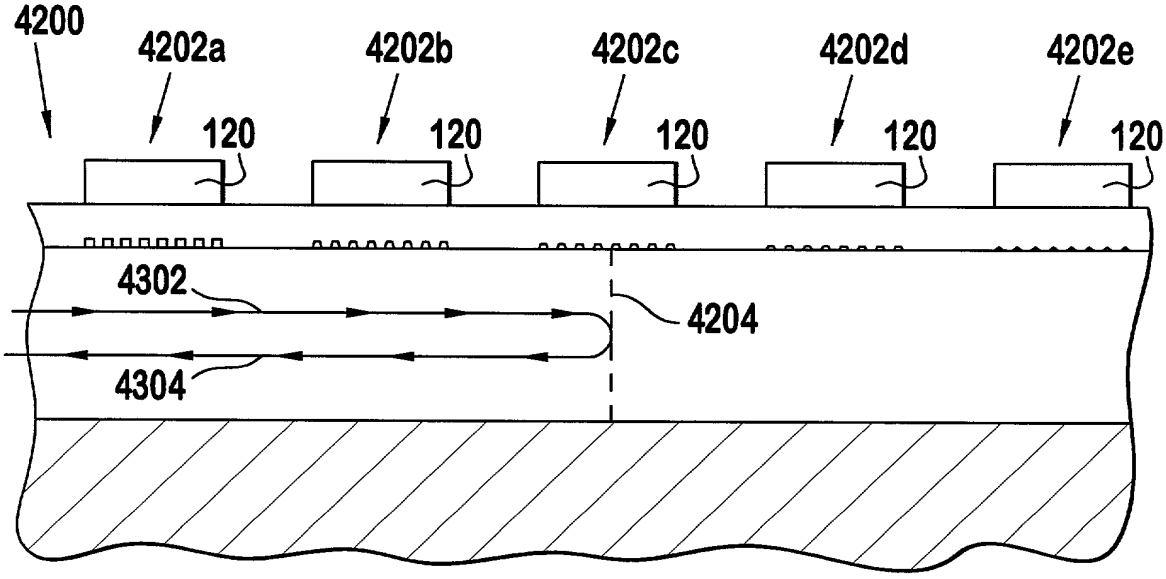

4200
4202a
4202b
4202c
4202d
4202e
120
120
120
120
120
4302
4204
4304

FIG. 44

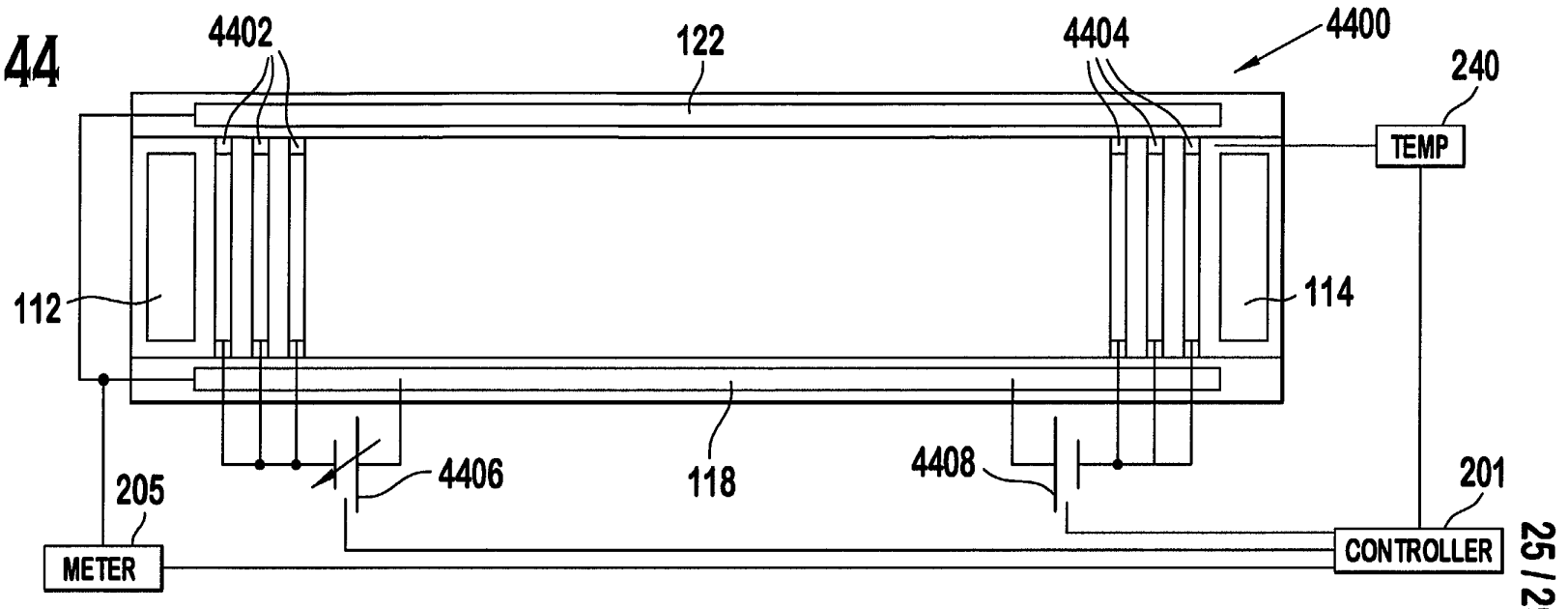

4402
122
4404
4400
240
TEMP
112
114
205
4406
118
4408
201
METER
CONTROLLER

FIG. 45

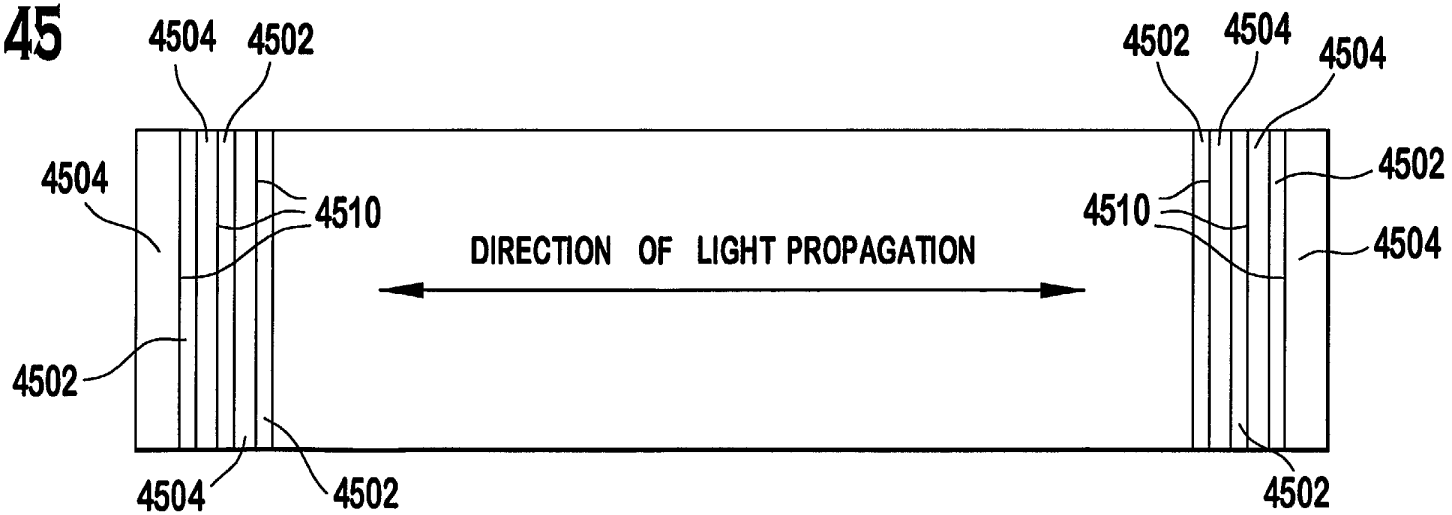
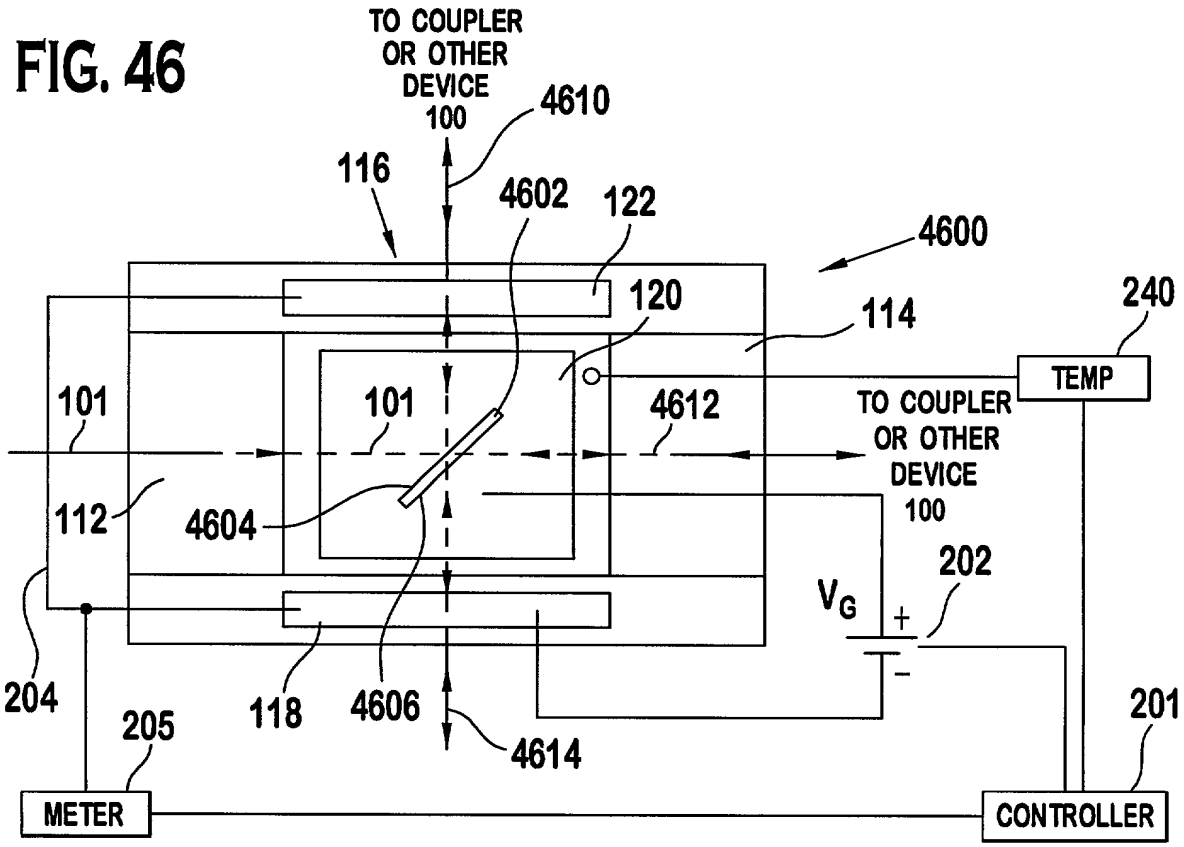

4504
4502
4502
4504
4504
4504
4510
4510
4502
4504
DIRECTION OF LIGHT PROPAGATION
4502
4504
4502
4502

FIG. 46


TO COUPLER OR OTHER DEVICE 100
4610
116
4602
122
4600
120
114
240
TEMP
101
101
4612
TO COUPLER OR OTHER DEVICE 100
112
4604
202
$V_G$
+
−
204
205
118
4606
4614
201
METER
CONTROLLER

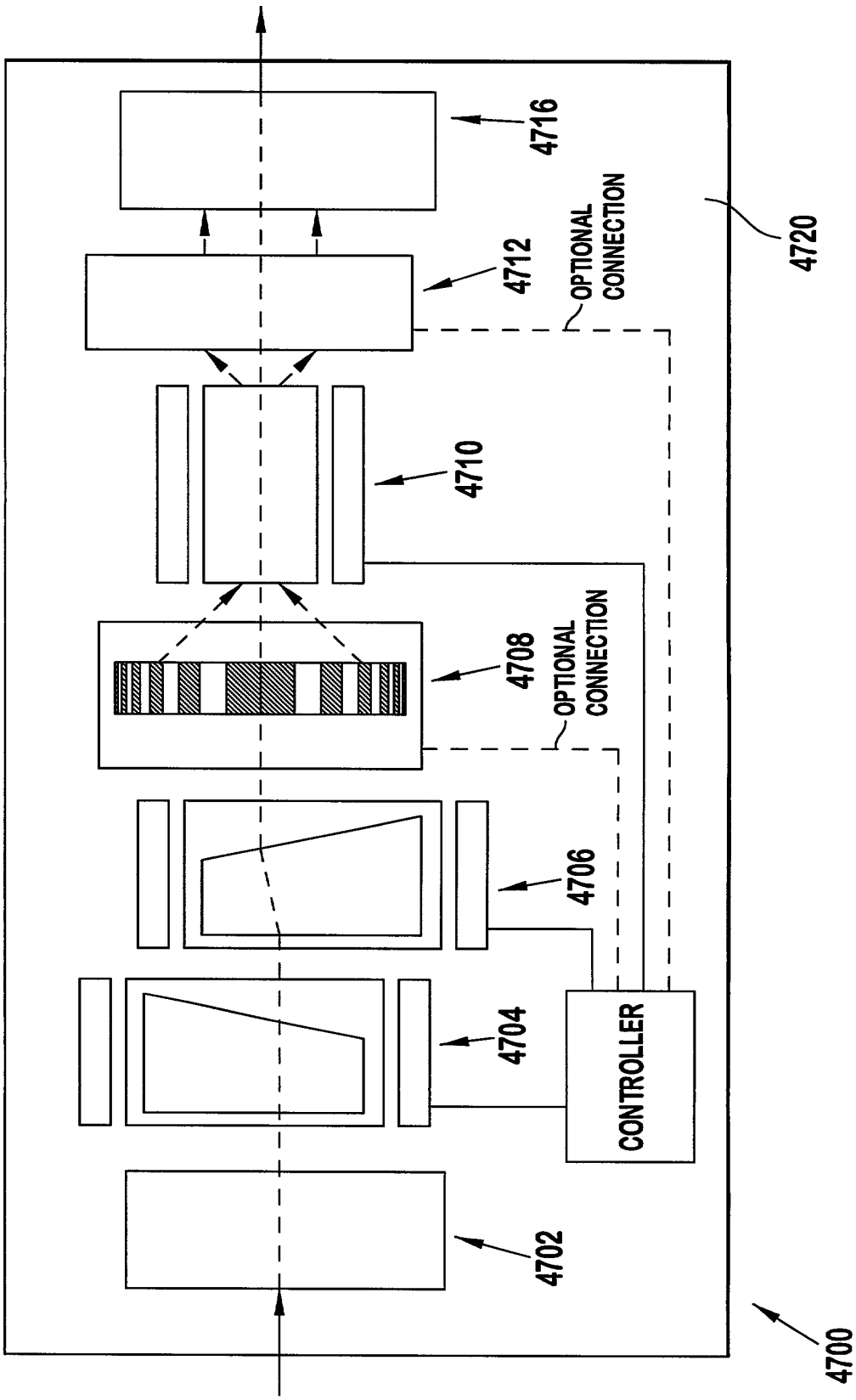

4716
4712
OPTIONAL CONNECTION
4720
4710
4708
OPTIONAL CONNECTION
4706
4704
CONTROLLER
4702
4700

FIG. 47

FIG. 48

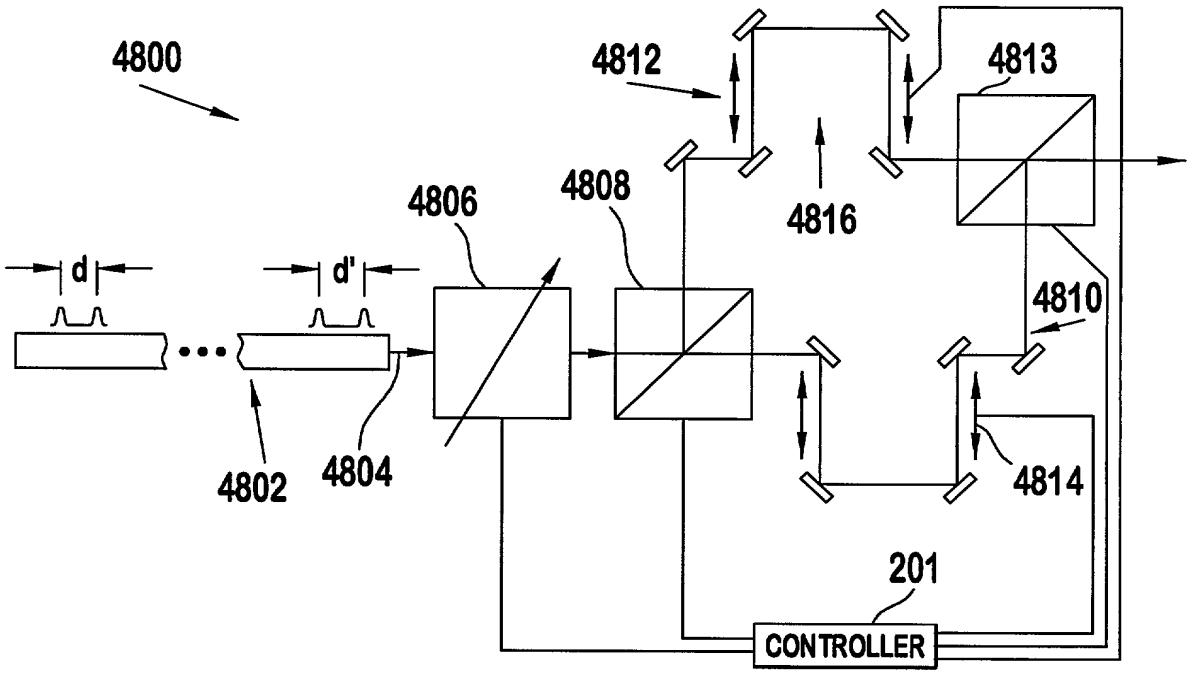

4800
4812
4813
4816
4806
4808
4810
d
d'
4802
4804
4814
201
CONTROLLER

FIG. 49

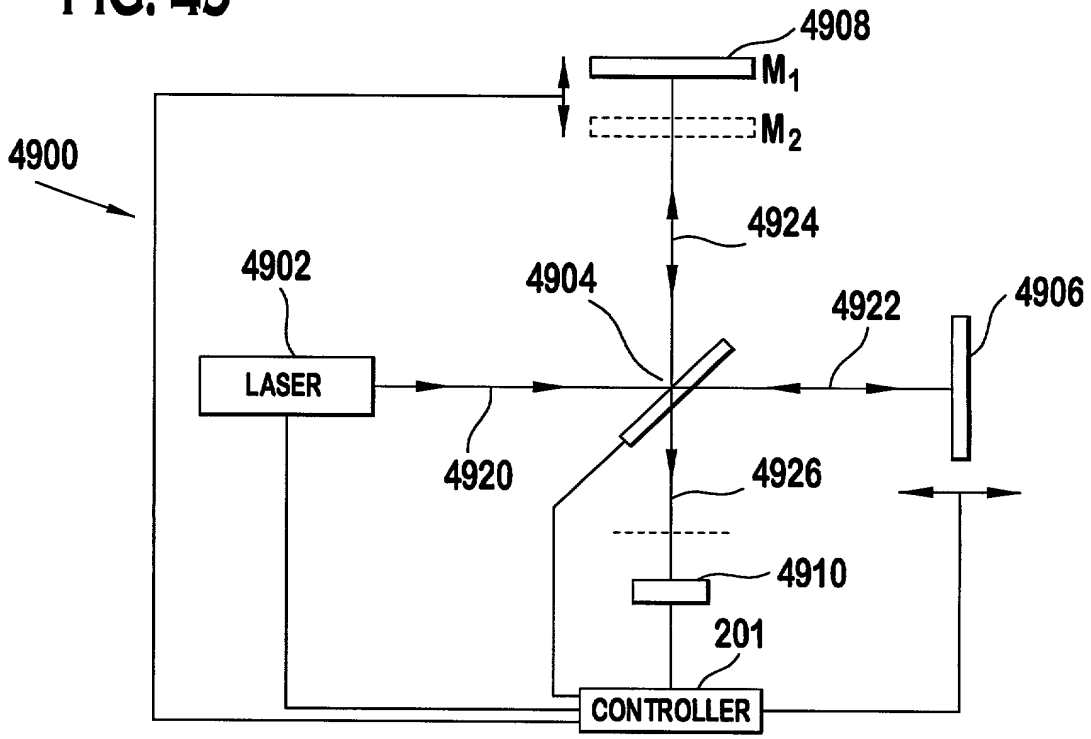
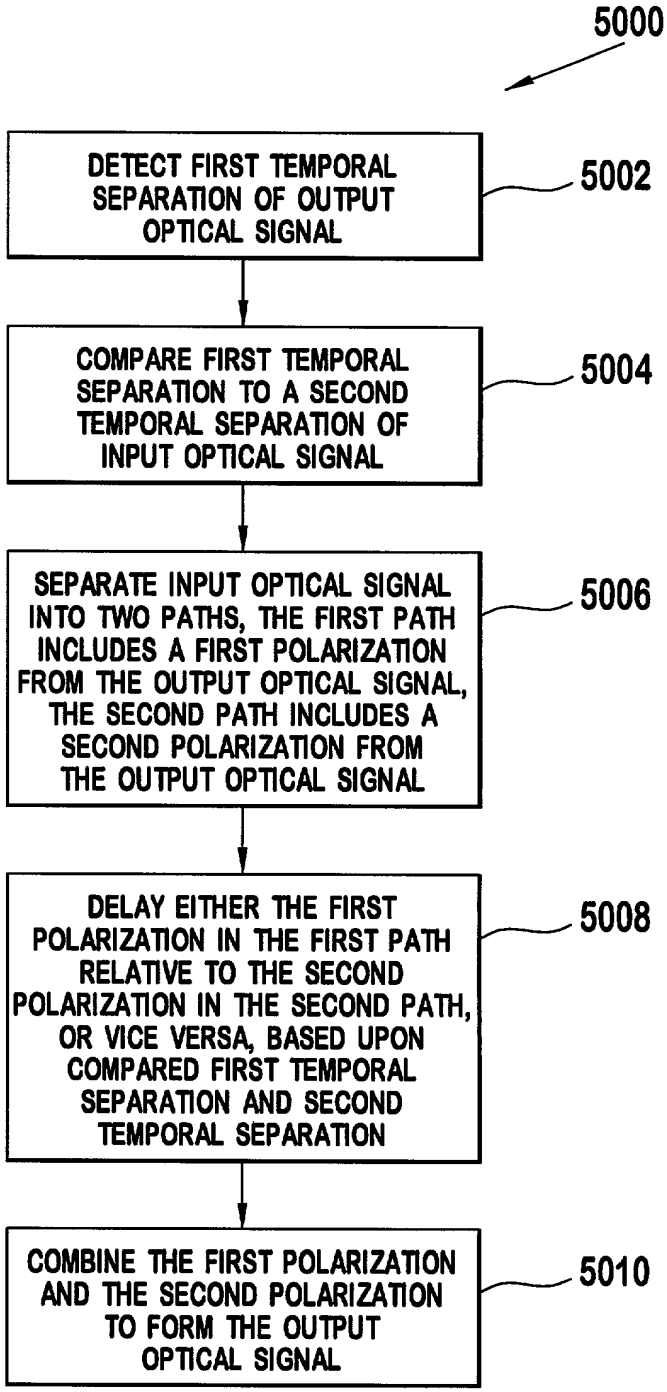

4908
M1
M2
4900
4924
4902
4904
4922
4906
LASER
4920
4926
4910
201
CONTROLLER

FIG. 50


5000
DETECT FIRST TEMPORAL SEPARATION OF OUTPUT OPTICAL SIGNAL
5002
COMPARE FIRST TEMPORAL SEPARATION TO A SECOND TEMPORAL SEPARATION OF INPUT OPTICAL SIGNAL
5004
SEPARATE INPUT OPTICAL SIGNAL INTO TWO PATHS, THE FIRST PATH INCLUDES A FIRST POLARIZATION FROM THE OUTPUT OPTICAL SIGNAL, THE SECOND PATH INCLUDES A SECOND POLARIZATION FROM THE OUTPUT OPTICAL SIGNAL
5006
DELAY EITHER THE FIRST POLARIZATION IN THE FIRST PATH RELATIVE TO THE SECOND POLARIZATION IN THE SECOND PATH, OR VICE VERSA, BASED UPON COMPARED FIRST TEMPORAL SEPARATION AND SECOND TEMPORAL SEPARATION
5008
COMBINE THE FIRST POLARIZATION AND THE SECOND POLARIZATION TO FORM THE OUTPUT OPTICAL SIGNAL
5010